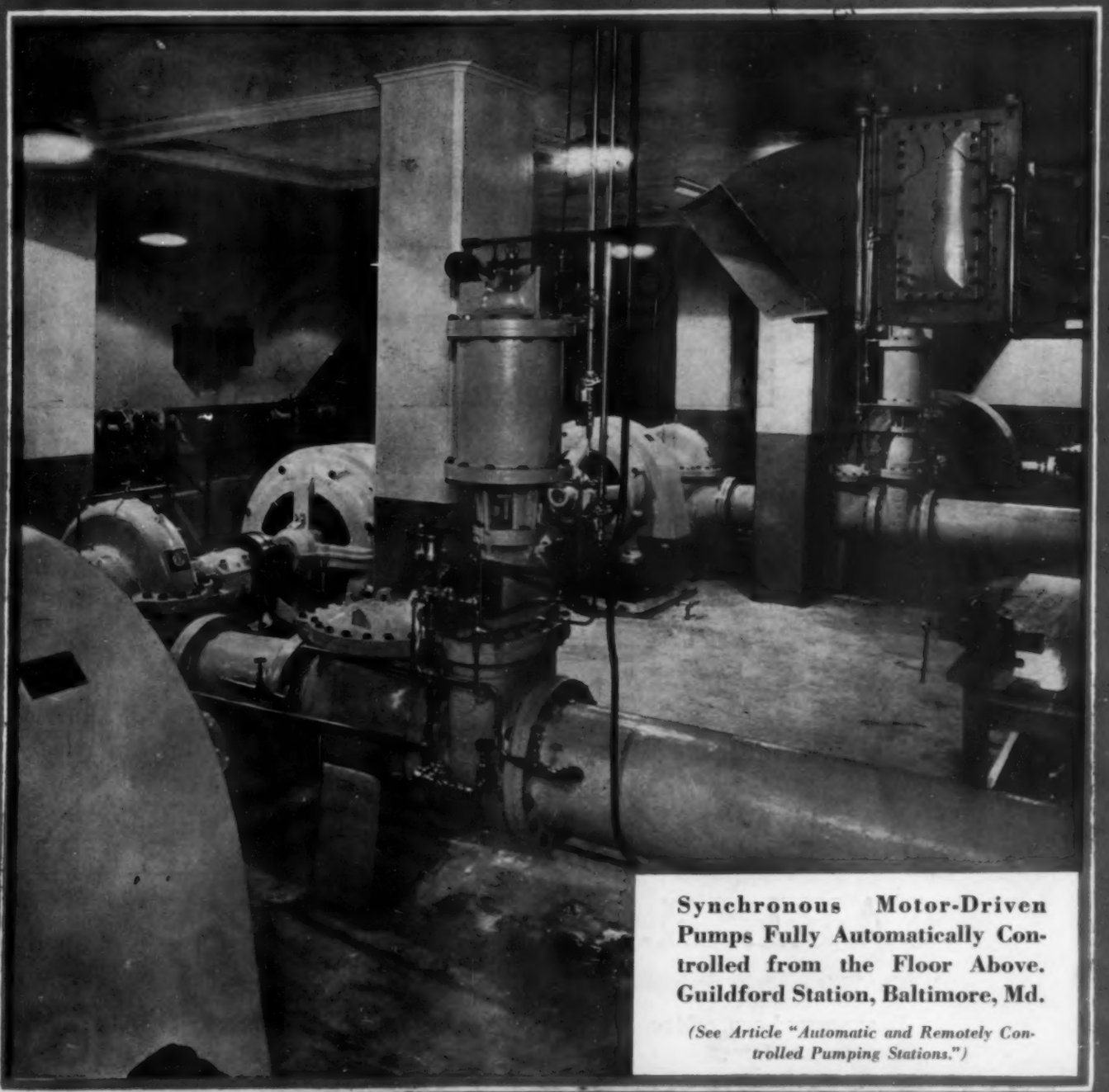
PUBLIC WORKS

CITY COUNTY STATE



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(See Article "Automatic and Remotely Controlled Pumping Stations.")

NOVEMBER, 1933

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VOL. 64 No. 11
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NOVEMBER, 1933

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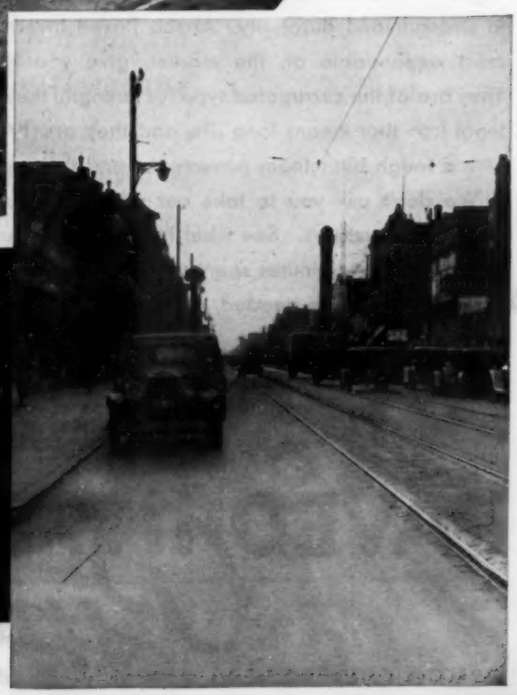
Do you make regular use of the Readers' Service Dept.?—see pp. 51-54

You Should about Paving



Do you make regular use of the Readers' Service Dept.?—see pp. 51-54

November 1933

PUBLIC WORKS

Vol. 64
No. 11

CITY, COUNTY AND STATE ENGINEERING AND CONSTRUCTION

TABLE OF CONTENTS FOR NOVEMBER, 1933

What Problems Are You Encountering Under the P.W.A.

A number of letters have been received from readers of PUBLIC WORKS telling of special problems which the writers have encountered in connection with P.W.A. allotments, or asking information concerning details of procedure.

While the P.W.A. section of the National Recovery Act was planned carefully in advance, it is only natural that many unforeseen problems and conflicts with the laws and practices of some of the many states should develop when attempting to carry out a program on such a vast scale.

Some difficulties have arisen due to lack of information or misunderstanding of the purposes of the act on the part of local officials. Others may be due to a failure on the part of the act to give sufficient consideration to special local conditions.

Such of the latter as develop from day to day are being acted on promptly by the P.W.A. Officials in Washington, but unless adequate publicity is given to these decisions and interpretations, other local officials who are experiencing similar difficulties may fail, through delay or discouragement, to obtain desired allotments.

PUBLIC WORKS would like to hear from all who have run into any such difficulties, whether in applying for loans or grants, in getting local approval for needed projects, in preparing plans, in carrying out the terms after the loan or grant has been made or others; and if the writers have obtained solutions of them, to learn what those have been.

By bringing these solutions to the attention of other public officials who encounter similar problems, and by obtaining official interpretations and decisions in the case of problems not previously passed upon, we will try to "do our part" in furthering the purpose of the P.W.A. and the interests of municipalities.

Won't you therefore write me personally as soon as possible about the problems you have encountered? I will endeavor to answer your questions promptly by letter.

A. PRESCOTT FOLWELL
Editor.

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A. PRESCOTT FOLWELL, *Editor*

W. A. HARDENBERGH, *Asso. Editor*

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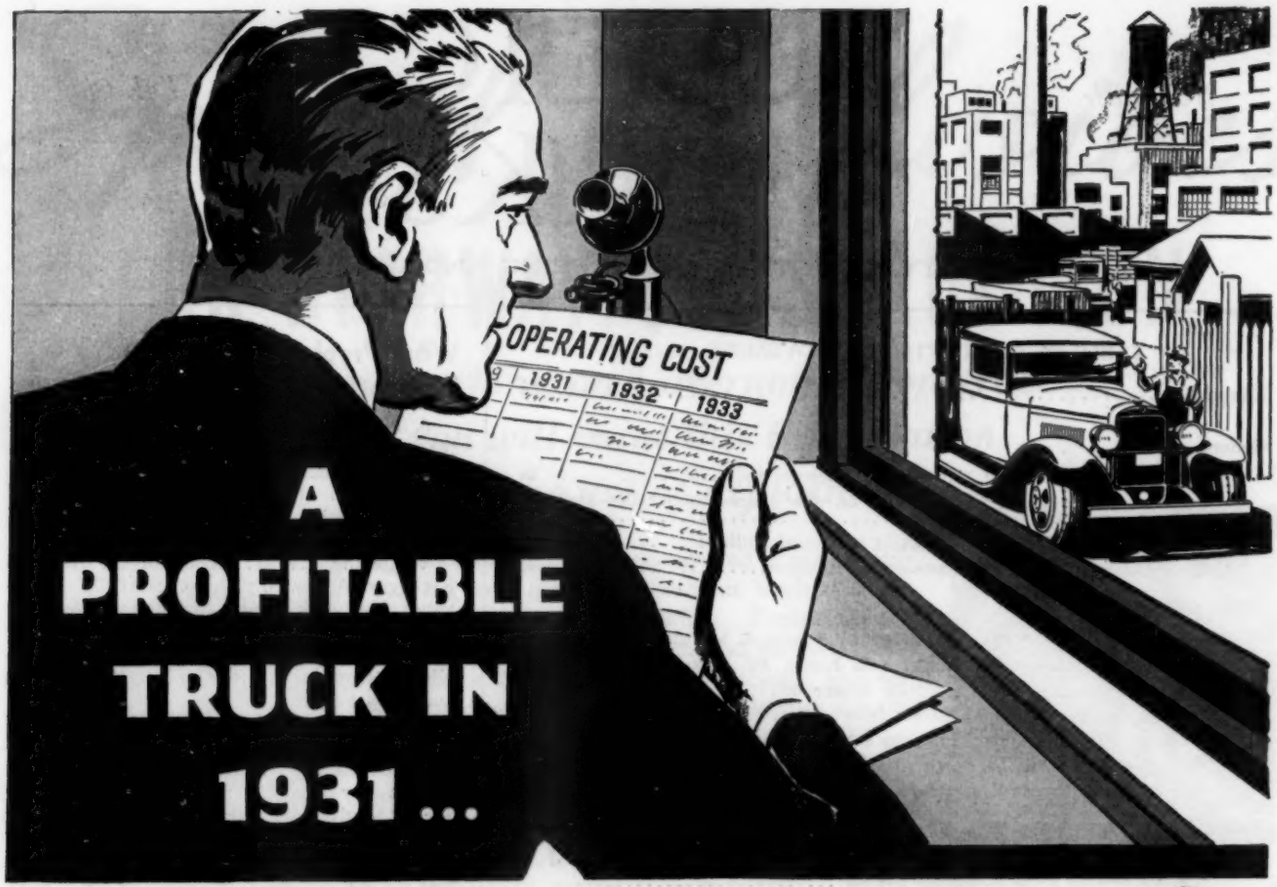
FOUNDED IN 1896



....a liability today?

That truck of yours that seemed a good asset at the close of 1931 *may be losing money for you today!*

Check up—and see.

Re-figure your 1931 operating costs *in terms of 1933 dollars.* Keep in mind the effect on costs that today's new business conditions have. You'll certainly find that many items included under operating costs have moved sharply upward—more, perhaps, than you realize.

Then—still working with 1933 dollars—compare these corrected costs with those you would be paying if your trucks were *new.* Some of your present equipment will, unquestionably, bear the comparison well. But you may find other trucks in your fleet that you could trade-in with benefit to your purse!

That's where the GMC line enters into your problem.

The GMC Truck and Trailer line—produced by the world's largest builder of commercial vehicles exclusively—is so complete and varied that it fits *every* hauling requirement from 1½ to 22 tons. Each model, furthermore, has *proved* its ability to do its work at less cost per ton-mile.

GMC power plants—6-cylinder, valve-in-head engines of the most modern type—*all* develop *more sustained torque per cubic inch displacement* than any other engines in their field do. The line consists of *six* engines—truck-engineered and truck-built for truck work exclusively.

Finally, every GMC vehicle—because of the unmatched facilities of General Motors Truck Company—*is fitted exactly* to the job for which it is purchased.

So—if your examination of operating costs uncovers unprofitable equipment in your service, be sure to investigate, thoroughly, the GMC line!

GENERAL MOTORS TRUCKS and Trailers

GENERAL MOTORS TRUCK COMPANY — *Time Payments Available Through Our Own Y. M. A. C.* — PONTIAC, MICHIGAN

Do you make regular use of the Readers' Service Dept.?—see pp. 51-54

PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 66 · *November, 1933* · No. 11

Re-Tread Pavement, Then and Now

By George E. Martin

Consulting Engineer, General Tarvia Dept., The Barrett Co.

"RE-TREAD" pavement was introduced in 1926 by the Barrett Co. as an economical type of resurfacing which could be done satisfactorily with unskilled labor and ordinary road machinery, using local material.

The original instructions were, briefly, as follows: Fill ruts, holes, etc., clean off dust and dirt, and spread a 2-inch depth of stone, ¾" to 1" size with a small percentage of finer. Rolling is desirable but not necessary. Apply 0.50 to 0.75 gal. of heavy Tarvia B. Open to traffic, but keep the surface shaped up with a blade grader (not turning over the entire depth, however) and use the roller if you have one.

When the road begins to ball up or roll into waves under the blade—generally in about 36 hours—stop blading. About the fourth or fifth day apply ¼ to ⅛ gal. of heavy Tarvia B; cover with screenings if you can afford it. When dry, roll if possible. For two or three days more keep a few laborers on the road shaping up the surface with hand tools.

With use, improvements have been made in this procedure. These include mixing the stone and tar, usually with some form of drag or multiple blade grader, and increasing the stone size slightly and the depth to 2½ inches loose. Machine mixing cuts down the mixing time and permits using a heavier binder. The importance of the seal coat was recognized, and the tendency has been to increase the amount of tar in the seal coat and pay more attention to thoroughly filling the surface voids before applying the seal coat.

The construction steps generally used at present are:

1. Patch and widen base if necessary.
2. Prime with 0.25 to 0.5 gallon of tar, unless base surface is tight.
3. Spread aggregate to depth of 2½ inches.
4. Apply 0.5 gallon of tar per square yard.
5. Mix.
6. Apply 0.4 gallon of tar per square yard.
7. Mix again.
8. Roll.
9. Fill surface voids with chips, or pea gravel, sweep and roll.
10. Apply ⅓ gallon per square yard of tar seal coat.
11. Cover with stone or slag chips or pea gravel.
12. Sweep and roll.

The tar used for a prime coat on the base is usually one having a specific viscosity at 40°C. of 8 to 13. For the mixing operations, a tar having a specific viscosity at 50°C. of 16 to 22 is used in spring and fall, and one of 26 to 36 in summer. Recently on some state highway work, a heavy surface treatment tar with a float test at 32°C. of 60 to 150 seconds has been used for the second mixing and seal coat, this permitting immediate rolling and earlier completion of the job if plenty of equipment and skilled operators are available. However, a local road official might get into trouble because of the necessity for working rapidly before the tar sets.

On something over 270 miles of tar bound Re-Tread built by the New York State Highway Department in 1932, the average cost was as follows:

Tar	13.7 cents per square yard
Stone	21.1 cents per square yard
Labor	7.1 cents per square yard
Total	41.9 cents per square yard

Maintenance should not be neglected on this type. Most Re-Tread jobs should have a maintenance seal coat the next year after they are built. After that, seal coats every three to five years should keep the surface in good shape. Entire replacement will not be necessary at any time if the foundation is adequate and the surface is kept sealed.

While the early Re-Tread was built with a broken stone aggregate, a considerable amount has been built using gravel aggregate. The best method appears to be to divide the gravel on the quarter-inch screen and start with aggregate ranging in size from ¼ inch to 1½ inches. About twenty percent of the material smaller than one-quarter inch is added during the mixing operations. The road is then finished and sealed in the usual manner.

Retread Over Concrete, N. Y. State Highway

Multiple-blade Mixing Machine.

Five Years' Operation of the Milwaukee Activated Sludge Plant

THE Milwaukee sewage treatment plant, which has been described frequently (see PUBLIC WORKS for January, 1924, January, 1928, and January, 1929) consists essentially of the following: Coarse and fine screening and grit chamber treatment; activated sludge treatment in 24 reverse-flow, ridge and furrow aeration tanks and 15 sedimentation tanks with Dorr and Tow-Bro sludge removal mechanism. The excess sludge is processed into fertilizer ("Milorganite"), using Oliver 12x14 ft. continuous vacuum filters, and modified Atlas type direct-indirect rotary dryers. The coarse and fine screenings (drum screen with 3/32 inch openings) and grit are incinerated.

The operation of the plant for the five years from Jan. 1st, 1928, to Jan. 1st, 1933, has been practically continuous, there having been only three temporary suspensions totaling five days to permit connecting new structures. The following data apply to these five years, during which the flow was quite uniform, being 81.84 mgd in 1929 and 78.98 in 1932, and averaging 80.48 mgd. The present flow originating in the district is 110 mgd and additions are under way (to be completed by Jan. 1st, 1935) which are estimated to be ample until 1946.

The sewage is strongly industrial (breweries, packing houses, tanneries, heavy machinery). Screened solids—total, 907 ppm; in suspension, 304 ppm; total screenings and grit, 29 ppm, of which about 2.3 ppm is coarse screenings, 9.7 is fine screenings and 17 is grit. Very uniform in character and strength, the latter varying not more than 7% either way from the average, as to solids, while the B.O.D. varied only 5% below and 3% above the average of 270 ppm.

The bacteria varied between yearly averages of 1,689,387 in 1928 and 2,776,225 in 1932 (20°, 48 hr. incubation). Monthly temperatures varied from 49° F. to 71° F. The pH averaged 7.16 in 1928-'30, and 7.4 in 1931-'32 when great quantities of pickling liquor were diverted from the sewers. The nitrogen averaged 40.6 ppm, of which 43% is found in the Milorganite and 32% in the effluent.

Aeration

Aeration tank maintenance consists chiefly of diffuser plate conditioning and renewal, and general tank cleaning. Of the 24 tanks, an average of 22.5 tanks were in continuous service; indicating that, in designing, the tank capacity should be made somewhat more than 6% greater than the theoretical.

Average period of aeration, 5.34 hours in the tanks, plus 1.26 hrs. in the various supply channels; air supplied, 1.22 cu. ft. per gal. in tanks and 0.28 cu. ft. in channels. Sludge circulated with sewage through tanks, 33.3% at 98.84% water, leaving 2/3 tank capacity for sewage. Effluent from subsequent aeration shows reduction of 97.5% of total initial bacteria, 93.5% of suspended matters and 95.4% of B.O.D.; stability by methylene blue test, 96.06 hrs.

The air diffuser plates in the supply channels are for purposes of agitating and mixing, preventing separation of solids, and keeping mixture of sewage and sludge in contact with air the maximum amount of time possible.

The quantity of sludge returned to the tank is determined from hour to hour on the basis of maintaining a mixed liquor suspended solids content of approximately 3,000 ppm, which is the optimum for the general condition encountered. As sludge concentration increases, the amount of sludge decreases and therefore the amount of mixed liquor; whence the detention period in aeration and sedimentation tanks increases, and either the degree of treatment or amount treated can be increased. Therefore further reduction in the water content of the return sludge is aimed at.

The suspended solids content of both mixed liquor and return sludge is determined hourly by the centrifuge method and checked in the laboratory at 4-hour intervals by filtering and weighing.

Sedimentation

Average detention period 2.3 hrs. Suspended solids content of sludge, 1928-1930, 1.06%; 1931, 1.23%; 1932, 1.37%. The increasing concentration during the last two years with similar detention periods was attributed to both increased operating experience and methods employed in removing deposited sludge from the tanks. The plant extensions are being designed on a basis of 1.5% suspended solids with 2.0 hrs. detention.

Effluents analyzed 0.8 ppm nitrites, 2.28 ppm nitrates, 18.4 ppm suspended solids. Suspended solids removal, 93.5%, raw sewage basis.

Tanks functioned at average rate of 1080 gal. per sq. ft. per 24 hrs. of mixed liquor, or 812 gal. of raw sewage.

Sludge Disposal

During the five years, 162,800 tons of fertilizer were produced, an average of 89.2 tons a day, analyzing an average of 6.95% NH_3, 2% available phosphoric acid, 3.83% moisture, 29.48% ash, 6.03% ether soluble.

The vacuum filters reduced the moisture content of the sludge from 98.63% to 83.6% (average values); and the dryers further reduced it to 3.83%; each square foot of filter averaging 158.5 pounds of dewatered sludge cake per 24 hrs., or 26.6 pounds on a dry basis. The number of filters used, however, decreased from 15.74 average in 1928 to 9.46 in 1932 through improved operation and control. On some days the maximum rose to 22.3, not because of increased quantity of sludge but because of its more resistant filtering characteristics.

Preliminary to filtering, the pH of the sludge was adjusted to the optimum for maximum filtration rates, this optimum being pre-indicated each day by filtering a sample (diluted to 1% solids) through a battery of Buechner vacuum funnels, each funnel receiving a portion of diluted sludge adjusted to a different pH. The pH of the most rapidly filtering sample is adapted for use that day, with possibly adjustments to accommodate changing conditions in filtering and drying. The optimum pH averages 3.87.

Up to the end of 1931 both ferric chloride and sulphuric acid (60° Baumé) were used separately and in combination for pH adjustment; but since then only ferric chloride has been used. The sludge is delivered at practically a continuous rate, and dilute ferric chloride is added at the rate to maintain the predeter-

mined pH, the average (anhydrous basis) being about 7.2 percent, equivalent to about 144 pounds per million gallons of sewage. The mixture is agitated 10 minutes by diffused compressed air and pumped to the filter tanks through soft rubber lined piping.

Each dryer has produced an average of 17.5 tons of Milorganite per 24 hours; one pound of coal screenings averaging 12,753 B.t.u. being used for producing 1.384 lbs. of Milorganite (1.49 lbs. in 1932 with 4.57% moisture content).

Incineration of Screenings and Grit

Digestion of screenings having been found impracticable, incineration of these and of the grit (which is highly putrescible) has been adopted. These are partially dehydrated in Tolhurst horizontal centrifugal machines, reducing the moisture of the coarse screenings from 88 to 72%, and of the fine screenings to 77%. The partially dehydrated materials are burned in two 20-ton, oil-fired Morse-Boulger refractory arch type incinerator units. This plant was placed in operation on Nov. 16, 1932, and up to Sept. 1, 1933, had burned 3,492 tons of grit, 394 of coarse screenings, 2,303 of fine screenings, and 211 tons of Milorganite dust from the dryers. In performing this, 172,602 gals. of fuel oil was used, averaging 19,320 B.t.u. per pound. To date the performance of the incinerator has been quite satisfactory from all angles, particularly that of unsightliness, there being neither smoke nor odors.

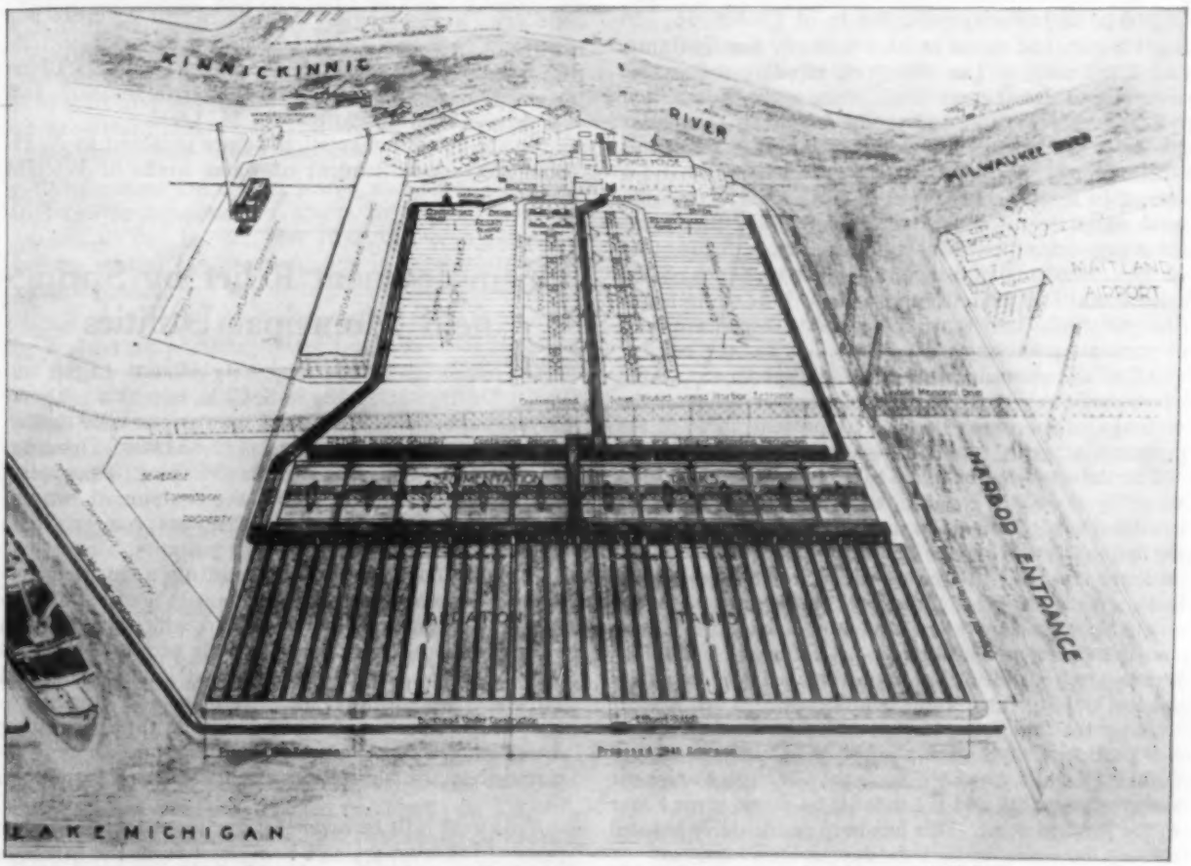
General

The facts herein are derived from a paper by Darwin W. Townsend, principal assistant engineer, Milwaukee Sewerage Commission. In that paper he stated several conclusions derived from the operating experiences.

These indicated that "accelerated rates of activity, the character of which have not as yet been clearly defined, are conducive to accelerated rates of sludge settling and solids concentration, even to the extent of involving difficulties in its removal from a sedimentation tank. At such times as this condition has occurred, most notably during the summer of 1932, settled sludge containing solids to the extent of 6 to 7 percent was formed on the bottom of the settling tanks, and microscopic examination of activated sludge floc revealed the presence of abnormally large numbers of filamentous growths among the other and usual micro-organisms present. The reappearance of this preponderance of filamentous growth during June of the present year (1933) was likewise accompanied by unusually rapidly settling sludge, the rapidity of settling and subsequent concentration having been checked by shortening the period of aeration. Little has been determined as yet relative to the functioning of this growth in the mechanism of sludge settling and concentration."

Referring to reaeration in channels, he said: "While it is a matter of record at this plant and, generally speaking, possibly a matter of sanitary engineering knowledge, that to reduce the air per unit volume of sewage aerated results in a lesser degree of purification, there may be some question as to the effectiveness or efficiency of air application in channels, this statement being offered with particular reference to the great variations in velocities and periods of air contact.

(Continued on page 47)



Milwaukee Sewage Purification Plant. Present plant, light; proposed additions, shaded.

Wichita Falls Water Works Earns a Profit for the City

Of a surplus of over $100,000 a year, part is turned over to the general fund

THE City of Wichita Falls, Texas, purchased the local water works property in 1920 for $800,000. The system was in need of various improvements, and bonds were issued at that time for $1,000,000, the additional $200,000 being used immediately for pumping equipment and extensions to the distribution system.

By the end of 1921 improvements had been made costing$271,343, the additional cost having been met by current revenue. These improvements included 10,536 ft. of 14-inch pipe, 2,724 ft. of 12-inch, 55, 120 ft. of 6-inch and 6,859 ft. of 4-inch; 80 fire hydrants, and 1,461 meters. The city grew rapidly, and it was necessary to make extensive additions to the distribution system each year, and during the following four years there were added 6,600 ft. of 20-inch and 81,340 ft. of 6-inch pipe, 1784 meters and 76 fire hydrants, and a second 10 m.g.d. centrifugal pump added to the high service equipment in 1925. During the next four years there were added 14,747 ft. of 14-inch pipe, 8,584 ft. of 12-inch, 46,680 ft. of 6-inch, 17,489 ft. of 4-inch; 3,588 meters, and 70 fire hydrants; and, in 1927, a half-million-gallon elevated tank. Since 1929 there have been no material additions.

All of the above improvements, except those covered by the original bond issue, have been paid out of the earnings of the department. The present value of the property is figured at $1,900,000.

The debt service on the $1,000,000 bonds has been borne by the city's general fund. But, to balance this, the department receives no revenue from private or public fire protection service nor for water used for street or sewer cleaning. Based on measurements and calculations made for other cities, the fire protection should entitle the department to an annual payment of $70,000; and the water used for streets, sewers, and other like services to $10,000. This would balance 8% for interest and sinking fund on the bonds.

Since the first year of city ownership the department has produced each year a surplus amounting to over $100,000, which has been more than enough to pay for the improvements and the balance has been turned over to the general fund. This has been particularly helpful during the emergency of the depression years.

All services are metered except private fire lines and the same rate schedule applies to all consumers, public and private, except that water used for public parks is sold to the park department on a cost basis. The maximum rate is 25 cents per thousand gallons and the minimum 13 cents, with a minimum monthly charge of $1.00, entitling the customer to 4,000 gallons. A great many customers use less than 4,000 gallons a month, and there are few industries whose consumption entitles them to the minimum rate, for which reason the average sale price for the past year was nearly 23 cents per thousand gallons consumed. The cost of water, including debt service, is just under 12 cents. The total gallons metered to consumers last year was 1,100,000,000, and the surplus was therefore about $121,000.

For the above information we are indebted to A. H. Douglass, superintendent of water works of Wichita Falls.

Unemployment Relief by Springfield Municipal Utilities

The municipally operated City Water, Light and Power Utilities of Springfield, Ohio, have this year employed more than 1,000 men on various construction projects costing approximately $1,833,000. These include clearing, foresting and landscaping; riprapping lake shores; new boiler and power equipment; two impounding dams; water mains; sewers; power lines; roads and bridges.

In addition they are undertaking a further program of permanent improvements with Federal aid involving expenditures of $1,681,516, which will furnish work for the citizens in 1934. This program includes pumping station and power plant at Lake Springfield and roads around the lake; filter plant and filtered water storage reservoir; elevated storage tank; pumping equipment; water mains; riprapping lake shores; replacing electric substations, and electric transmission lines.

This work will be carried out without increasing the general tax levy, the cost being met from the earnings of the plant without increasing the rates.

Guildford pumping station, with synchronous motor-driven pumps. Full automatic control on main floor.

Outdoor hydraulic generating station at Unionville, Conn. Switch houses in the background.

Automatic and Remotely Controlled Pumping Stations

A LARGE item of cost in a steam pumping plant is the wages for engineer and fireman, at least one of each for each plant. With the introduction of internal combustion and especially of electric drive, the possibility of reducing the control to a visit by the superintendent once or twice a day has stimulated invention, and it is possible now to install a plant which will start and stop under pre-determined conditions or at pre-determined times, and signal the office if anything goes wrong.

Where there are several plants, such as a main plant and two or three booster plants, or several deep-well plants, all can be operated from the main plaint by remote control by one man, who is kept informed by automatic signals of any desired conditions at all plants.

A recent rather spectacular illustration is afforded by a plant for pumping water from the Colorado river, at Indian Garden Springs, to the top of the canyon wall, a total lift of 3153 feet to the top of the tanks which receive it. Two units were installed, each consisting of two 17-stage, vertical, centrifugal, turbine type pumps, each driven by a 60 h.p. 3600 r.p.m, 2300-volt, squirrel-cage induction motor. Each unit can handle 85 g.p.m. against a head of 3400 ft. Three-phase, 60-cycle, alternating current is supplied from the power house on the river through an armored cable.

The pumping station can be reached only by a narrow trail down the cliff, and distance control was very desirable and has been obtained by the "visicode" system, which requires only two telephone-type line wires between the top of the canyon and the pumping plant. The operator at the power house can: 1—Start or stop either unit, and receive a signal of whether or not it is running; 2—Open or close the drain valve, and receive a signal of whether it is opened or closed; 3—Control, and receive an indication of the position of, the check valve jackscrew adjustment; 4—Receive an indication of low water in the reservoir; 5—Receive low-temperature indication; and 6—Ring and connect telephones at each station to line wires for communication.

In explanation of No. 5, part of the pipe line down the cliff is exposed to the air, which reaches a temperature of 20° F. A thermostat was installed in the pipe at the most exposed section, which indicates dangerous temperature by ringing a bell and changing lamps on the operator's panel, and he can then either start the pumps or drain the line. It is expected that a weekly visit of general inspection is all that will be required.

An entirely different plant is the 50 m.g.d. Guildford Station in Baltimore, probably the largest completely automatic water pumping station. Theoretically, no attendant is required, as all of the functions are performed automatically by means of magnetic control actuated from pressure gauge relays or similar master control. A pump in service continues to run until the reservoir is within 3 in. of being full, when a valve controlling the flow into the reservoir is closed automatically, which slightly increases the pressure in the pipe, which in turn causes a pressure relay to start the shut-down operation of the control equipment. A timing clock is started by the shut down, and at the end of a pre-determined time interval the pump is again placed in service. This *full automatic control* is used extensively for small stations, especially where only a day operator would otherwise be required.

More commonly used, especially for the larger plants, is the *full magnetic type*, which requires only the operation of a button or master control switch for starting or stopping a pumping unit. Even the operation of auxiliary equipment, such as main valves, priming pumps, etc., can be included in this starting cycle and interlocked so as to secure the desired sequence. This greatly simplifies the starting operation and relieves the attendant of much of the responsibility for correct operation of the equipment.

Some starters, particularly for synchronous motors, are *semi-magnetic*, i.e., part of the starting cycle is per-

Guilford pumping station, located in residential section of Baltimore

formed automatically in order to simplify the operation for the attendant.

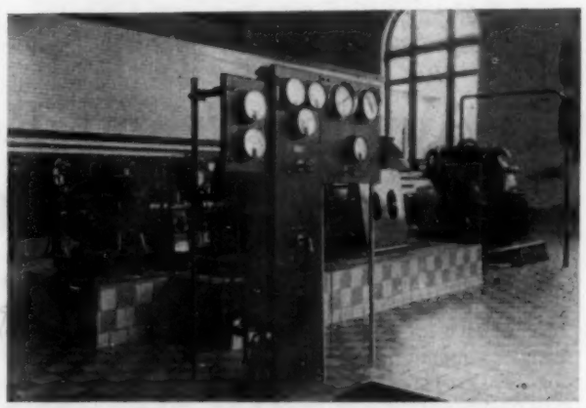
Remote direct wire control is used where the booster or other station is in the same locality as the high-lift station, as it requires a large number of control wires between the two plants, especially if signals are included. One attendant can regulate the operation of both the booster and high-lift stations from a common control desk, where are master control buttons, meters, signals, etc. In the new water works station at Erie, Pa., the master control is in a control desk on the balcony of the high-lift station, from which a single operator has complete control of the two stations and of the filtration plant, including operation of two main breakers, control of three synchronous motor pumping units and of synchronous motor field rheostats for power factor correction; also, for the low-lift plant, starting vacuum pumps which in turn start the low-head pumps selected, auxiliary control for mixing tanks and stopping of day feed mechanism, auxiliary control of balancing pumps, and control of wash pump; with various indicating lights and meters.

Supervisory control is used in place of the remote direct wire control where the drop on the control becomes prohibitive. (This was the type of control described above as used at Indian Garden Springs.) Various systems are available for securing this control, but the three in general use are the synchronous visual, coded impulse (called "visicode") and direct selection (called "polaricode"). For pumping plant operation, two wires would handle all the operations required.

The visicode uses relays similar to those employed for years in automatic telephone systems. There is a button with indicating light for each operation. When the operator presses a certain individual selection key, this causes a pre-determined number of impulses to be transmitted to the equipment in the station, which energize the selection relay corresponding to this particular code and the same code is then repeated back to the control desk and lights a corresponding selection lamp there, informing the operator that the circuit between the control desk and the circuit breaker has been established. He then moves the control key to the "closed" position and depresses the master control key. When the circuit breaker has operated, the green "breaker open" light is turned off and a red "breaker closed" light is lighted and the equipment returns to normal position of rest.

A pumping station could be equipped with full automatic control operated from pressure relays or similar equipment, with complete shutdown of the units in case of trouble, in which case a supervisory control would theoretically be required to handle only the major operations with direct indication in case a fault develops. It is desirable, however, to have complete indication of the position of all circuit breakers, controllers, and valves, and auxiliary control of all the major units with at least means of checking the operation of each unit and the plant as a whole. This would require remote metering of pressure and flow gauges and possibly voltage and current meters. It would be possible to have even power factor control if desired.

Automatic or remote control involves use of motor starters. These may be either full voltage starters or reduced voltage starters. Most squirrel cage and synchronous motors are designed for full voltage starting, i.e., throwing the motor directly on the line through



Master control board for magnetic starters. Two 3800 hp. synchronous motors, Belmont pumping station, Philadelphia

the main or running switch. The rulings of the power company furnishing the current, however, may require use of reduced voltage starters, of which there are three classes: Auto transformer, reactor, and resistance. The first gives the lowest starting current for the torque delivered but produces a second current surge in the power line. Reactor starters are generally specified for large motors, particularly for pump drives, as the starting torque required by a centrifugal pump is low. Resistance starters are used for small motors.

The above is greatly condensed from a paper before the central States Section, American Water Works Ass'n, by R. C. Allen, general engineer, Westinghouse Electric and Manufacturing Co.

Cincinnati's Water Works Operation in 1932

Despite the reduction in receipts, due to unemployment conditions, operations of the Cincinnati water works showed a surplus of $280,648 during 1932. The gross income from water sales amounted to $2,200,844, and other revenues to $77,459. The operating expenses were $1,197,229, and interest charges, depreciation, bond retirements and capital improvements were $800,396.

Water consumption for 1932 was 4% less than for 1931.

The annual report states: "The 90,000 consumers of Cincinnati enjoyed their first full year of a water supply without obnoxious phenol tastes and odors. The operation of the ammonia chlorine process at the filtration plant is responsible for this improvement.

The Digestion Tank

A Digest of the Sewerage Literature of the Month

IN SEWAGE TREATMENT the outstanding features of the past year have been[12] 1—Widespread revival of interest in chemical precipitation. 2—Development of more direct methods for handling sludge. 3—Improvement in mechanical equipment.

In well designed and operated plants, the percent reduction in B.O.D. obtainable averages: fine screens, 8; plain sedimentation, 35; sedimentation, sprinkling filters and secondary sedimentation, 85; activated sludge, 90. The percent removal of suspended matter is: fine screens, 12; plain sedimentation, 60; sedimentation, sprinkling filters and secondary sedimentation, 80; activated sludge, 92.

Of the new adaptations of chemical precipitation which have been investigated experimentally, the best known are the Laughlin (Dearborn, Mich.), Guggenheim (North Side works, Chicago), Stevenson (Palo Alto), and Streander (N. E. Works, Philadelphia).

Utilizing old treatment plants in a new plant of different type was illustrated by the new activated sludge plant at Newark, N. Y.[27] One of the two sludge digestion tanks was a reconstructed Imhoff tank. A sludge storage and conditioning tank was made by covering the existing final settling tank. A sludge drying bed was made by alteration of existing sprinkling filters and erection of a glass enclosure. An office, laboratory and equipment building was furnished by altering, repairing and enlarging the existing pumping station.

A *venturi flume* is an important part of the grit chamber of the Newark, N. Y., plant, causing the depth of flow through the two chambers to vary in accordance with the flow so as to maintain uniform velocity. It also serves as a meter and is provided with an indicating, integrating and recording device. It is of the design suggested by Ralph L. Parshall, irrigation engineer of the U. S. Reclamation Service.

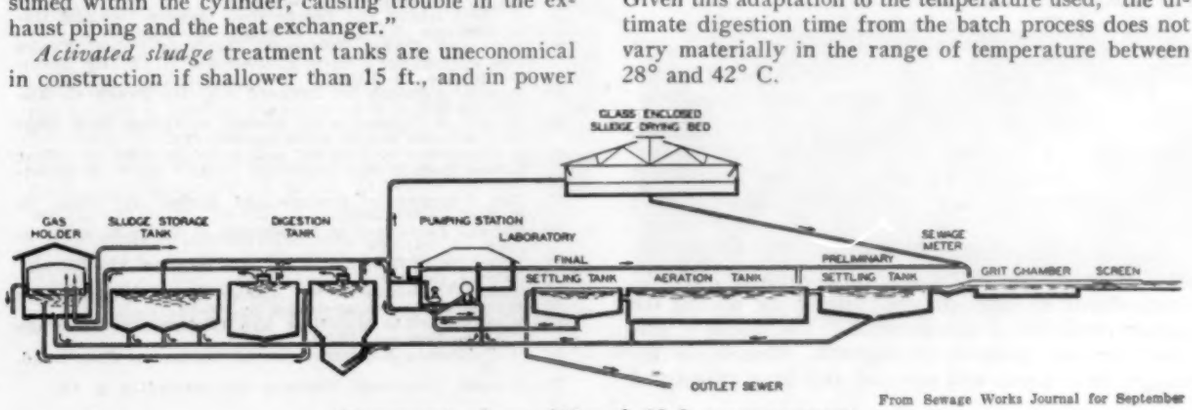
The *gas engine* for utilizing the sludge digestion gas to drive the blower at the Newark, N. Y., plant has given trouble due to pitting of the exhaust valves, causing loss of compression. "The gas has been unusually high in H_2S, which burns slowly and is not fully consumed within the cylinder, causing trouble in the exhaust piping and the heat exchanger."

Activated sludge treatment tanks are uneconomical in construction if shallower than 15 ft., and in power for air compression if deeper than this[28]. With spiral flow, wider tanks can be used than with ridge and furrow—even wider than the depth—thus reducing construction cost and giving more surface aeration. The possible formation of a dead water core in the axis of the tank is sometimes prevented by transverse diffusers at intervals. With a well designed plant, 6 hours of aeration and 1.0 cu. ft. of air per gallon of sewage is average practice. The area of diffusers should be at least one-tenth of the tank area. Strong sewage requires either longer aeration or more air per gallon than does fresh dilute sewage.

Larger bubbles from higher permeability diffusers than were formerly advocated are now found satisfactory; less air pressure is required; and the greater vertical velocity of the bubbles gives a high overturning effect in spiral-flow tanks, and the larger pores do not clog as readily as fine-pore diffusers. Apparently spiral flow requires about 25% less air than ridge-and-furrow design.

Pre-Aeration is used[28] for floating oil and grease for skimming off; for odor control; for improving the efficiency of preliminary settling. For these purposes ridge-and-furrow tanks and fine-pore diffusers seem best; detention periods of 10 to 30 minutes and 0.05 to 0.1 cu. ft. of air per gallon of sewage. Pre-oxidation of trickling filter influent for 2½ hours at Decatur, Ill., using 0.4 cu. ft. per gal., increased the capacity of a trickling filter three-fold.

For *thermophilic digestion*, the optimum temperature range is 50° to 55° C.; for non-thermophilic, about 28°. But little is known of the effect of temperatures between these two optima[23]. Experiments indicate that sludge produced at 20° requires a period of adaptation and acclimatization to give the most efficient digestion at higher temperatures; used to seed fresh sludge which was incubated at a higher temperature, there was a prolonged lag in rate of gas production; but if this sludge was used to seed fresh solids to be incubated at the same higher temperature, and this be repeated, adaptation seems to be complete with the third incubation. Given this adaptation to the temperature used, "the ultimate digestion time from the batch process does not vary materially in the range of temperature between 28° and 42° C.



From Sewage Works Journal for September

Diagrammatic scheme of Newark, N. J. sewage treatment.

The B.O.D. determination "is apparently subject to more variations and discrepancies due to, as yet, unknown causes than any other test used in the sewage works laboratory."[26] Mr. Eldridge believes that "given the same quantity of organic material, the results will vary with the number of bacteria initially present when the sample is set away for incubation," which is possibly one of the factors in causing the discrepancies above referred to. In investigating the subject, Eldridge seeded sterile sugar solutions with sewage and incubated them up to 20 days, and found that "the quantity of seeding added greatly affects the values obtained. . . . The variation is undoubtedly due to a lag in the development of the organisms in the cases where the initial numbers are low. The B.O.D., at least up to 7 days' incubation, may vary to such an extent as to be almost directly proportional to the quantity of seeding added. The final (20-day) B.O.D. appears to reach about the same value with all quantities of seeding." However, "there appears to be an optimum quantity of seeding above which correct results are possible" even for 5-day incubation.

Pumping sewage and sludge presents conditions differing considerably from pumping water and the equipment should be adapted to those conditions. The subject was treated thoroughly but concisely by Charles E. Greene.[31] Non-clogging centrifugal pumps are generally used, but if the rate of pumping is less than 400 gpm, pneumatic ejectors are preferable for sewage and reciprocating pumps for sludge; and a head of over 100 ft. is not desirable. To cover the range of dry-weather flow of sewage, one pump is uneconomical, requiring large storage capacity (the pump should not stop and start more than four times an hour) but two, one about half the capacity of the other, will generally suffice.

A two-blade impeller will give much less clogging trouble and can be run at higher speeds than one with one, three or four blades. A bar rack of 2 to 2.5-inch opening ahead of a sewage pump is desirable, but a pump that will not operate without a screen should not be used. Check valves are necessary; horizontal ones seldom clog badly, vertical ones always do.

Vertical pumps are generally preferable to horizontal; but the latter give pleasanter working conditions, permit a greater variety of driving units and possess other advantages, especially for large plants. But if the station is to be unattended or area is limited vertical pumps are indicated.

For sludge there is nothing better than centrifugal pumps. There is little evidence that they break up the floc more than other pumps. Reciprocating pumps used for small volumes of sludge are usually "mud-hogs" with minor changes.

Compressed air is used for handling sludge by means of a pot-type ejector or vertically by air lifts; but should not be used for pumping into or from closed tanks because of possibility of explosive air-gas mixtures.

The *pump well* of the Chester, England, sewage works has been provided with "an arrangement of air pipe in the bottom of the pump well, and compressed air can be blown upwards to prevent the deposit of solid matter."[7]

Pumping sludge through 20,466 ft. of 8-in. cast iron pipe from Detroit to the Dearborn sewage treatment plant offered an excellent opportunity for testing the friction coefficient of this material.[13] The line is of uniform size and material throughout. Before use for sludge, clear water was pumped and at a velocity of 3.15 ft. per second the Hazen-Williams coefficient was 140, and at 4.06 ft. it was 137, agreeing closely with the coefficients for the very best c.i. pipe conditions. Soon thereafter sludge of 99.5 moisture content was pumped at 2.96 ft. per second and the coefficient was 126. The sludge changes its moisture content frequently so that at no time is it uniform throughout the pipe line; but when a composite of hourly samples gave 99.1 moisture, a velocity of 2.64 gave a coefficient of 110.

There has been only one stoppage in this long sludge line, and this was easily removed by raising the pump pressure temporarily from the normal 51 lbs. to 140 lbs.

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Long-base steel drag, for drag treatment

Spreading half-inch chips as cover material.

Tar Drag Treatment of Pennsylvania Roads

By A. R. Taylor

Engineer, Tarmac Dep't, Koppers Products Co.

IN 1931, when the State of Pennsylvania took over 20,000 miles of township roads for maintenance (which in that state includes reconstruction), it was confronted with the problem of resurfacing quickly a large part of this mileage. Because of the extent of the mileage and nature of the traffic, low cost construction was indicated, and many types of this were tried out. One developed in the Pittsburgh district which has proved to be one of the most satisfactory and economical, is tar drag treatment on a local native stone base course.

In constructing this type of road, local native stone is dumped on the graded surface, where it is napped to sizes of 5" or under, and is then spread to a depth of 8" or more to give a compacted depth of at least 7". After being brought to a uniform surface, the voids are filled with shale or other local material, and on it is spread enough screenings—200 to 300 tons per mile —to thoroughly fill the remaining voids. This base is then rolled and opened to traffic. No water is hauled for puddling and expense for this is eliminated, but the surface is rolled immediately after every rain.

In most cases this base is topped with a bituminous surface from a week to two months after construction, and the method now being used in the Pittsburgh district is to apply a drag surface ¾" to 1" deep. All loose material is swept from the base course; this being done by hand labor to give employment to as many as possible, although in normal times most of the sweeping would be done with mechanical sweepers. Following this, a prime coat of tar is applied at the rate of 0.2 to 0.25 gallon per square yard. A few years ago the state used for this class of work a very light grade of tar having a specific viscosity of 5 to 8.5 at 40° C, but for these native stone bases, which are very open, tar having a specific viscosity of 17 to 22 at 50° C is being used, equivalent to 38 to 53 at 40° C. As cooler weather came in the fall, a lighter material was used.

After the prime material has thoroughly soaked into the road, from 50 to 60 lbs. per square yard of 1" crushed stone (from 1¼" to ⅝") is spread uniformly over the surface, usually directly from trucks. In some few cases where it has been spread ununiformly a drag is used to remedy this.

The loose aggregate is then treated with 0.2 to 0 25 gal. of tar with specific viscosity of 26 to 31 at 50° C, immediately followed with a similar coat applied in the opposite direction; the State engineers having observed that when any bituminous material is applied by pressure distributor one side of the aggregate is better coated than the other.

The surface is then dragged with a steel multiple-blade drag weighing approximately 1,200 lbs. This not only mixes the tar with the aggregate but also tends to eliminate any depressions in the surface, greatly improving the smooth riding qualities of the surface. Usually the drag is pulled by a small tractor and makes two round trips over the road. The surface is then rolled immediately.

Approximately 24 hours after rolling, the seal coat is applied. It consists of an application of .2 to .25 gallon per square yard of a heavy grade of cold application tar having a specific viscosity of 26 to 31 at 50° C. This is covered with 5 to 10 lbs. per square yard of stone chips, ranging in size from ⅝" to ¼". The chips are applied only in sufficient quantity to permit the surface to be rolled without picking up. Again we find on most of the projects that the chips are being spread by hand, in order to give maximum amount of employment to labor, although the State has a large number of chip spreaders. The surface is rolled imme-

(Continued on page 33)

Rolling road after chipping.

Osaka, *Japan's Great Industrial Center,*

Includes Modern Sewage Disposal in Vast Development Program

By Isador W. Mendelsohn

OSAKA, the largest commercial and industrial center of Japan, with a population of 2,453,569, is situated on Osaka Bay in the southwestern part of Hondo, the main island. The city is typical of the remarkable development of Japan. Yesterday, one might say, Osaka was a feudal town where the famous Dojima rice exchange flourished and wealthy merchants' boats navigated the rivers and canals delivering goods to various islands of the empire. Today, it is one of the greatest industrial centers of the world, surrounded by an enormous manufacturing district with numerous high smokestacks and huge industrial plants. The city covers an area of over 70 square miles. The more than 5,600 factories located here produce dyeing and weaving machinery, various utensils, chemical products, foodstuffs, beverages, silk, cotton cloth and cotton textiles, and miscellaneous articles. At present Osaka is undertaking a tremendous development program, laying streets and pavements, water mains and sewers, constructing a subway, and sewage treatment works.

As in the case of other Japanese cities, the night soil for many years has been collected and disposed of on neighboring farms for fertilizer use. It has been difficult to get people to remove this fecal matter at reasonable rates, and inefficient handling in the past has caused typhoid epidemics. The septic tanks serving large buildings overflow to the rivers. Foul matter has been disposed of into the canals and rivers of the city for so many years and in such ever increasing quantities that stream pollution in the civic center is increasingly obnoxious. Because of these conditions, an activated sludge experimental plant, Ichioka, was completed in 1925. It serves a population of 26,000 and treats a dry-weather flow of 1,280,000 gallons in the west central part of Osaka. The plant consists of grit chamber, preliminary settling tank, ridge and furrow type of aeration tank, two sludge settling tanks, and one reaeration tank, and cost 130,000 yen ($65,000).

The Plan Adopted

Tests on this experimental plant were made for the sewer department for the period 1925-1928 by the chemist of the City Hygienic Laboratory. As a result of the findings, the City Planning Board of Osaka decided on a plan of sewage treatment which was approved by the Imperial Government on May 29, 1928. According to this plan the city is divided into five separate sanitary districts, each with its own pumping stations and sewage treatment plant. Construction was begun on this project in 1930 and it is expected that by 1935 the two central area plants will be in operation. In view of the present widening and paving of streets, sewers are being laid in many sections of the city. As money is made available in the future, the other treatment plants will be installed to provide complete sewerage facilities for all Osaka.

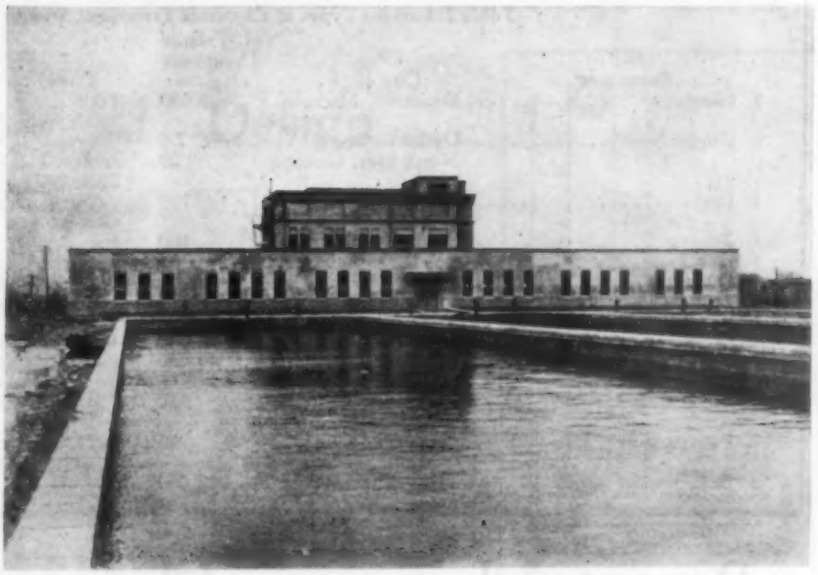
The central district has an area of 9.3 square miles and a population of 1,185,000. The two activated sludge treatment plants and sewers for this area will cost 17,000,000 yen, or 14.35 yen per capita contributing. The population density is from 180 to 240 per acre, and the maximum rainfall is about 2.4" per hour. The sewers will be of the combined type largely, of round vitrified clay, and horseshoe and rectangular concrete pipe or reinforced concrete according to the quantity of flow. Their size will be based upon estimated sewage flow of 53 gallons per capita per day, a velocity of 1.5 feet per second for dry-weather flow and of 5.9 feet per second for wet-weather flow. Up to three times the dry weather flow will be treated by the plants, all in excess of that being led to the rivers or bay.

One of the two plants, Tsumori, located on the Kizu river in the south-central part of Osaka, will receive the sewage from an area of about 5.4 sq. miles and population of 734,000. The area of the plant will be 14.5 acres, and the capacity 37.2 m.g.d. The excess storm flow will pass through bar screens and detritors to the Kizu river.

Primary sedimentation tank, Dorr clarifier, Shibaura treatment plant.
(See September issue)

The two grit chambers will have bar screens. The settled matter will be collected by scrapers and removed by mechanical equipment. The maximum detention of the wet-weather flow will be one minute. The pump house will contain twelve pumps for the entire flow, five being for the dry-weather flow. To reduce the cost of operation of secondary treatment, two preliminary settling tanks are provided, 90′x90′x13′ side-water depth, in which the average sewage flow will be retained approximately one hour.

From the preliminary tanks, the effluent will flow by gravity to six double around-the-end type, spiral flow aeration tanks, each 88.6′x18.7′x15′ deep, with porous plates for air diffusion. The air pressure will be 7.1 pounds per square inch. The tanks will provide a detention period of 5½ hours for the dry-weather flow. Sludge of 98% moisture equal in volume to 20 percent of the sewage flow will be returned to the aeration tank.



Kunishima water filtration plant, showing the settling basins.

Three secondary settling tanks will be 110′x110′x13′ side-water depth, will give two hours detention for the average flow and will have mechanical rotating scrapers forcing the sludge to the center. The effluent will pass to the Kizu river.

Two sludge tanks 64′ in diameter x 12.5′ side depth will have a total capacity of 1½ days excess sludge and will be provided with rotary scrapers. The sludge, 185,000 gallons daily of 96 percent moisture content, will be barged to low areas or used for fertilizer, or dumped at sea. In case of electric current troubles, a by-pass prior to the grit chambers will permit the sewage to join the effluent from the secondary clarifiers.

The Ebiye activated sludge treatment plant, the second under construction for the central area of Osaka, is located in the northwestern part of the city on the Shinyodo river. It will serve a population of 451,000 in an area of 3.9 square miles. The plant will consist of two grit chambers with mechanically cleaned screens; four pumps for dry weather flow and five for wet weather flow; two preliminary settling tanks 70′x70′x12′ side-water depth; six aeration tanks 608′x16.4′x15′ depth, with 5½ hours detention period, and spiral flow; four secondary settling tanks 73.3′x73.3′x12′ depth with a capacity each of 477,000 gallons; and two sludge storage tanks of 49.2′ diameter x 12.5′ depth. The daily production of sludge of 96 percent moisture content is estimated at 116,500 gallons.

Water Supply of Osaka, Japan

Water is obtained from the Yodo River at a point 20 miles below the sewer outfalls of Kyoto. Between Kyoto and Osaka there are a few villages which contribute sewage and other waste matter to the river. Since Kyoto is now proceeding with plans for sewage treatment works, the pollution of the river will be greatly reduced in the near future.

In August, 1925, the fourth stage of the waterworks program for Osaka was begun, and was completed in March, 1930, at a cost of Y7,711,681 ($3,850,000). Including the water mains, the cost was Y35,000,000 ($17,500,000). This extension was based upon the estimate that in 1936 the city's population would be 3,100,000 of whom 2,750,000 would require water at the rate of 54 gallons per capita per day. The water purification plant was installed at Kunishima and consists of slow sand filters of 152,000,000 gallons daily capacity. Water is pumped to the settling basins where, after alum is added, it is retained for two to six hours according to the amount of turbidity in the water. Then it is passed through slow sand filters each 200′x200′ at a rate of 4 m.g. per acre per day. The clear water basins have a total capacity of 33 m.g.

The rapid sand filters were installed since the completion of the slow sand plant and have a capacity of 26 m.g.d. and cost Y900,000. Alum is added to the raw water at the rate of 10 p.p.m. The filtered water is chlorinated by manual controlled machines with chlorine cylinders on platform scales, the dosage being 0.25 p.p.m. to 0.30 p.p.m.

Future extensions to Osaka's waterworks system provide for installation commencing the latter part of 1933 of additional rapid sand filters with a capacity of 75 m.g.d. to cost Y16,350,000, including the laying of water mains. This program will take five years for completion and will involve the installation of pumphouses, mixing chambers, sedimentation basins, filters, and chlorinators.

Acknowledgment is gratefully made of the assistance of Messrs. H. Fujita, Guchi Suzuki, J. D. Hitch, and Y. Shionoya in the collection of data in this article.

This article and one in the September issue describing the Tokyo sewerage system were written by Mr. Mendelsohn from information obtained during a visit to that country this year. In a third article he will give brief descriptions of the Nagoya and Kyoto systems. While American engineers may as yet have little to learn from the Japanese, it is interesting to learn how rapidly they are adopting American sewage treatment practice in their large cities.

Table I. Various Types of Chemical Treatment Sewage Processes

Name of Treatment	City	Vol. Treated Thousands of g.p.d.	Chemicals Used	Remarks
1. Loughlin	Dearborn, Mich.	3,000	$FeCl_3$ or $Fe_2(SO_4)_3$ Paper pulp, Cl_2	$Fe_2(OH)_6$ + insoluble solids
2. Guggenheim	Dyckman St., N. Y.	2.5	$Fe_2(SO_4)_3$, CaO, Zeolite, MaCl for Zeolite, H_2SO_4 for ash	Unique, Highest degree of purification of all. Ferric hydroxide and zeolite
	North Side, Chicago	25		
3. Lewis	Atlanta, Ga.	500	$FeCl_3$, CaO, Fe SO_4 Cement dust	$Fe_2(OH)_6$ + insoluble solids
4. Travers	Ashland, Ohio	500	$FeSO_4$, CaO, Marl $Al_2(SO_4)_3$	$Fe_2(OH_3$ + insoluble solids
5. Diamond Alkali Co.	Cleveland, O.	50 (?)	Cl_2, $FeCl_3$, CaO	$Fe_2(OH)_6$ + Cl as finish
6. Streander	Philadelphia	30	Fe SO_4, CaO, air	$Fe_2(OH)_6$ + Cl as finish
7. Stevenson	Palo Alto	36	Fe Cl_3, Cl_2	$Fe_2(OH)_6$ + Cl as finish
8. Landreth	Winston-Salem, N. C.	6,000	CaO (electric current)	$CaCo_3$ + Mg $(OH)_2$
9. Wright	Rockville Center, N. Y.	3,000	Paper pulp (CaO)	Vacuum filter
10. Cabrera	Wilmington, Del.	60	$Al_2(SO_4)_3$, Cl_2	$Al_2(OH)_6$ + Cl as finish
11. Miller-Koller	Kirnhurst, Ill.	130	CaO, Cu So_4, Na_2CO_3 Al_2O_4, Cl_2	$CaCo_3$ + Mg $(OH)_2$
12. Putnam	Valparaiso, Ind.	25	$FeCl_3$, CaO Charred sludge	$Fe_2(OH)_6$ + insoluble solids
13. Scott-Darcey	Oklahoma City	2,500	Fe, Cl_2	$Fe_2(OH)_6$ + Cl as finish

Recent Advances in Chemical Treatment of Sewage

ALTHOUGH no chemical precipitation plant on a large-scale operation basis is now in service, F. W. Mohlman, in a paper before the A. P. H. A., classified the various other methods of chemical treatment in use as: (1) addition of coagulants, as ferric chloride, ferric sulphate, ferrous sulphate, lime, chlorine, alum, sodium aluminate and copper sulphate; (2) addition of insoluble materials, as paper pulp, marl, cement dust, returned sludge and ground charred sludge; (3) removal of soluble solids by zeolites and chlorine. The different types of chemical treatment processes are given in Table I.

In regard to results obtained, as shown in Table II, chemical precipitation processes fell between plain sedimentation and activated sludge treatment, giving reduction of 60-75 per cent in B.O.D., which may be boosted 5 per cent by chlorination: and 75-95 per cent removal of suspended solids. Chemical precipitation provides a sludge which (1) filters well on mechanical filters; (2) gives a filter cake with a moisture content usually lower than filtered digested or fresh sludge; (3) if loaded with lime, is not objectionable as regards odors; (4) has a dry weight 2-3 times the weight of the sewage dry suspended solids; (5) does not digest satisfactorily; (6) may cause odors, unless loaded with lime; (7) probably involves greater cost of operation than present treatment methods. In comparison with earlier chemical treatment plants in 1890-1900, Mohlman notes (1) more accurate methods of control of coagulation; (2) better coagulants, $FeCl_3$ in liquid form being convenient; (3) mechanical settling tanks are now used almost universally; (4) the B.O.D. test now available is a better measurement of the results of treatment; (5) for filtration of chemically clarified sewage, the use of zeolite is novel and interesting. The meagre and unconvincing data from chemical precipitation plants in comparison with results from activated sludge treatment works are too incomplete to furnish definite conclusions. According to available results, only the Guggenheim process approaches or equals the activated sludge treatment, and seems the most promising of all chemical precipitation processes. The experience of the past 5 years shows the value of continuous vacuum filtration of sludge for initial dewatering.

In discussing Mr. Mohlman's paper, Waring stated that at Circleville, Ohio, which has a population of 70,000 and a domestic sewage flow of 200,000 g.d. with a B.O.D. of 300 p.p.m., the Travers treatment with marl, ferrous sulphate and lime, was tried recently on the domestic sewage alone. Trade wastes with a B.O.D. of 17,000 p.p.m. were not tested. Results of a check-up by the State Department of Health for two months showed reduction in suspended matter of 92 per cent and a final B.O.D. of 72 p.p.m. The dissolved oxygen in the effluent was 4 p.p.m. of which 1 p.p.m. was due to air aspiration. The cost of operation was $132 per m.g. of sewage treated, divided 1/3 each among labor, chemicals and power. The State Department of Health advises cities not to spend their funds in testing proprietary chemical treatment processes, but to require the companies backing them to do so, the city paying for the plant when it has been proved a success. Waring expressed the opinion that chemical precipitation will be satisfactory for sewage treatment under certain limited conditions.

Table II. Results Obtained in Chemical Treatment Sewage Processes, and Three Activated Sludge Treatment Plants

Chemical Treatment Process		Suspended Solids	B.O.D.	
1. Laughlin	Dearborn	91	66	
	Coney Island	84	69	(without Cl)
2. Guggenheim	Chicago	95	90	(incomplete data)
	Dyckman St.	99.5	96.7	
3. Lewis	Atlanta	76	77	
4. Travers		85	50	
7. Stevenson	Ashland	95	95	
8. Landreth	(indefinite)	87	88	
10. Cabrera		89	78	(Claimed)

Activated Sludge Treatment (1930-1932, Average Daily Analyses)

			Air, cu. ft. per gallon
Milwaukee	93	95	1.63
Chicago	90.1	92.1	0 43
Indianapolis	89.6	91.7	0.92

Retaining Wall Design

Reinforced Concrete Walls

The second of three articles on designing retaining walls. The first appeared in the August issue.

IN designing reinforced concrete walls, the principles enumerated in the article on page 33 of the issue of August, 1933, apply just as in gravity walls, so far as overturn, sliding, crushing or settling are concerned. Approximately the same width of base is required, but because steel is used to take some of the stress, the design produces a wall of distinctly different section.

Various short cuts in design are available. In the issue of PUBLIC WORKS for July, 1932, D. Y. Bate gave tabular data for standard designs for cantilever and gravity walls. Somewhat similar material can be found in various textbooks, including Harger & Bonney's Highway Engineers' Handbook. For those who wish detail information, presented in a clear and simple manner, covering all phases of retaining wall design, we recommend "Design of Retaining Walls" by Samuel Baker and A. deGroot, director and assistant principal of the Civil Engineering Schools, International Correspondence Schools.

Procedure in Design

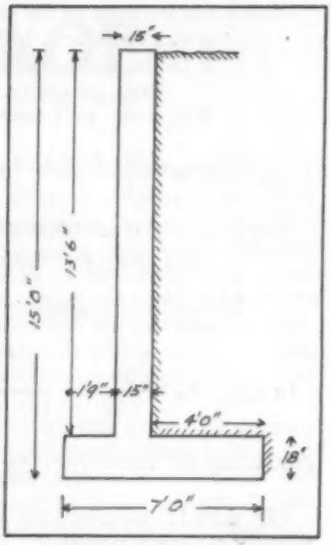
The first step in design is to assume, and then to determine, the width of base necessary to insure stability against overturning. The width must be such that the resultant of all the forces acting on the wall remains within the middle third of the base. For a wall without surcharge, a base width of 0.45 to 0.50 of the height is required, and for a wall with a surcharge a base width of about 0.60 of the height. The thickness of the base and of the stem are assumed and, though these original assumptions may differ quite materially from the dimensions later computed, the difference in the final result will be negligible, as a rule.

The determination of stability is done in the same manner as shown on page 33 of the August issue of PUBLIC WORKS. Assuming a wall, such as shown in the drawing, with a height of stem of 13.5 feet, a total height of 15.0 feet, a base width of 7.00 feet and a base thickness of 1.5 feet; the angle of repose of retained material 35°; weight of retained material 110 pounds per cubic foot; and weigh of masonry 150 pounds per cubic foot.

The computations described in the August issue will show resisting moments of 41,220 pounds, and an overturning moment of 16,800, with the resultant passing 2.43 feet from the toe, or within the middle third. The pressure on the base will be, with e=1.07 ft., 2,755 pounds at the toe and 115 pounds at the heel.

We will now proceed with the design of the stem, and determine the reinforcing required. The following values are adopted:

Stress in steel, $f_s = 16{,}000$
Stress in concrete, $f_c = 600$



Dimensions of wall used in computations

$n = 15$
$k = 95$
$j = .880$

The height of the stem above the base is 13.5 feet and the thrust, t, on the stem is

$$t = \tfrac{1}{2}wh^2 \tan^2\left(\frac{90-d}{2}\right) = 2725\#$$

The moment M equals the thrust times the lever arm, which is 1/3h.

Then $M = tL = 2725 \times 4\tfrac{1}{2} = 12{,}260\#$

The thickness of the wall, d, is shown by the equation

$$d = \sqrt{\frac{M}{K}} = \sqrt{\frac{12{,}260}{95}} = 11.35$$

Using the next highest whole number, d =12", and with 2 inches cover for the reinforcement, the thickness of the wall at the base will be 14 inches.

To compute the effective depth to resist shear,

$$t = 2725$$

$$d = \frac{2725}{.88 \times 12 \times 40} = 6\tfrac{1}{2}''$$

Therefore, there is no danger from shear.

The required top thickness will be much less, but in practice will depend on the batter used and whether or not a coping is desired. To compute the required thickness of the wall at a point one-third the distance from the bottom to the top, use the formulas above for t, M, and d, using 9 for h and 3 for L. It will be seen that d at this height is less than 9 inches, including cover for the steel. A similar computation can be made for 2/3 h. Generally it is cheaper, and gives a better appearance, to build the wall with a straight batter or a straight face than to break the face. The top of the wall should have a minimum thickness of about 8 or 9 inches, exclusive of a coping, but may be greater due to local conditions. Where the wall is thicker, a slight reduction in steel area can be made.

The required steel area is shown by either of the formulas:

(1) $a = pbd$

Where a is the area of the steel,
p is a coefficient, in this case .0068
b is the width of the strip under consideration, generally 12″
d = is the wall thickness

$$(2) \quad A_s = \frac{M}{f_s jd}$$

In (1) $a = pbd = .0068 \times 12 \times 11.3 = .925$
and using ¾″ round bars, area .442

$$\frac{12 \times .442}{.925} = \text{spacing of } 5.7'' \text{ on centers}$$

$$\text{In (2)} \quad A_s = \frac{M}{f_s jd} = \frac{12{,}260}{16{,}000 \times .88 \times 11.2} = .0777$$

And using ¾″ round bars, $\frac{.442}{.0757} = 5.7''$ on centers

(If d = 12 is used, the two formulas will give slightly different results.)

Steel Area at Various Heights

These entire computations can be carried through to determine the area of steel and the spacing of the bars at ⅓ h and ⅔ h. Generally it is permissible to stop about one-half of the rods at a point about ⅓ h from the base, and one-half of the remainder somewhat below ⅔ h. In this case, the spacing at the top would therefore be about 23 inches, and at about ⅓ h would be 11½ inches.

Design of Base

Having the distribution of pressure on the foundation, as determined in a preceding paragraph, the upward reaction of the soil under the toe projection of the wall can be computed. In the example given, this amounts to 4240 pounds. The weight of this toe projection is 395 pounds and the shear at the edge is 3845 pounds. Using the shear formula

$$d = \frac{V}{jbv} = \frac{3845}{.88 \times 12 \times 40} = 9+''$$

and with 3 inches for steel cover, the necessary thickness of the toe cantilever is only 12 inches. Therefore the base thickness adopted, 18 inches, is unnecessarily great.

Steel area is computed by the formula already given for A_s, computing the soil reaction around the edge of the stem by taking moments. With the bending moment as 3455 ft. pounds, A_s, when the base is 18″ thick (less steel cover), is .017 and when it is 9.3 inches thick, is .026 per inch.

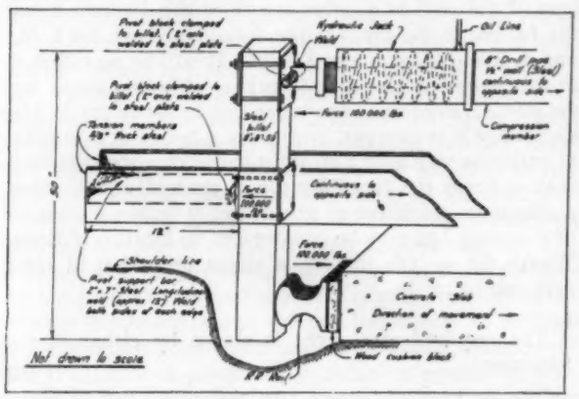
Spacing of half inch bars would be

$$\frac{.196}{.017} = 11\tfrac{1}{2}'' \text{ and } \frac{196}{026} = 7\tfrac{1}{2}''$$

The design of the heel projection is carried out in the same way, taking into account the weight of fill over the projection, the weight of masonry in it, and the upward soil reaction due to pressure on the base.

Longitudinal reinforcement in the stem and base should be provided as well as temperature reinforcing.

Bars designed to carry the stress in the stem due to the retained material should be placed about 2 inches from the rear face. In the toe projection, reinforcing may be needed in both top and bottom. In the heel projection, generally only at the top. The stem bars must be tied into the base, which is generally done by bending them, in which case they can also be used for reinforcing the toe projection.



Isometric sketch of movable end of pavement jacking assembly.

Forcing Slabs Into New Alignment

ENGINEERS of the California Department of Public Works have developed a device for pushing back into place 50-ton concrete slabs which had been moved in both horizontal and vertical position by the earthquake of March 10th. At fifteen points along a distance of ten miles of Route 60 there were horizontal displacements ranging from 2¼ to 8½ inches for stretches of 140 to 400 feet of pavement. There were also numerous vertical displacements, but slabs at these points were brought back to grade by the standard mudjacking outfit.

The shoving was done by means of two levers, one set vertical on each side of the three-course pavement, the fulcrums tied together by two 40-foot strips of ⅝″ x 8″ steel, and the tops of the levers forced apart by means of a jack attached to the end of a well casing 8⅝″ diameter and extending horizontally across the pavement from one lever to the other. The levers were 8″ x 8″ steel billets 50″ long. The lower end of each billet pressed against a 24″ length of 80 lb. rail, the base of which was separated from the vertical edge of the concrete slab by packing pieces of Oregon pine to distribute the pressure. The well casing was supported on a 2½-ton trailer and the steel fulcrum plates suspended from it. The vertical position of the latter could be raised or lowered to vary the leverage, which was generally about 2:1, a jack pressure of 40 to 45 tons giving the pressure of 75 to 90 tons necessary to start the slab, after which 30 to 50 tons slab pressure completed the movement. An oil-operated hydraulic jack was used, force being supplied by a small triplex pump. The jack plunger moved at a rate of a little over an inch a minute, and the pavement moved 4″ at a set-up.

Before moving the slabs, the longitudinal openings between slabs were thoroughly cleared of all materials to a depth of 2″ below the concrete; and at each joint in the pavement the shoulder was excavated to subgrade for a length of 3 ft. to receive the lever and its 24″ length of rail.

A total of 3,370 ft. of opened joints averaging 4.47″ wide were closed at a cost of $710 for labor and $156 for rental of equipment. (The cost of building the jacking outfit is not stated.)

THE EDITOR'S PAGE

Get In Your Applications for PWA Funds AT ONCE

"It is doubtful whether, in the next generation, money for providing needed and necessary public improvements can be obtained so cheaply as at the present time. When allocations from this fund have all been made, the State Advisory Board does not want any public official in North Carolina to be able to say that he was not fully informed regarding the eligibility of projects or the attractive financial terms offered." So says H. G. Baity, state engineer for the North Carolina State Advisory Board. And it will be just too bad if any city officials anywhere regret, when it is too late, that they did not know about this opportunity or did not act on the knowledge.

As an illustration of the advantage to cities of accepting the Federal offer, the experience of Macon, Ga., may be cited. In the last days of October Macon received bids on improvements to its water treatment plant, asking contractors to submit two bids, one based on conforming to the PWA regulations as to labor and the other without doing so. Bids on the former basis totaled about $124,000 and on the latter somewhat over $119,000. The city decided to accept the former and the Federal grant, which was estimated to be slightly more than $33,000, as doing so would benefit it to the extent of about $29,000.

We have tried to make sure that all readers of PUBLIC WORKS have the necessary information. In our October issue we told how to make application for a grant or a grant and loan. (A grant is obtainable without a loan and can generally be put through more quickly.) On page 25 of this issue will be found further details, as given to the A.P.H.A. at its convention by representatives of the PWA. There is a general belief (justifiable, it would seem) that there was at first unnecessary delay in Washington in preparing the machinery for making applications for grants and loans; but this has been working for some weeks and the administration is now doing its best to induce cities to take advantage of the opportunity. Several hundred million dollars are still unallotted, but January 1st has been set as the dead line, and it is announced that any part of the 3.3 billion dollars not then allotted will be used for Federal projects.

Precedence is being given to sewerage and water works projects. According to Malcolm Pirnie, deputy administrator of the PWA, construction of these has been much below the pre-depression rate for three years past, and there must be many cities—probably the majority—which should greatly increase their expenditures along sanitary lines to bring themselves up to normal. Other "needed and necessary" improvements are not excluded by any means, and projects for refuse disposal, parks, bridges, etc., will receive favorable consideration.

We advise every city to determine what improvements it needs and consult with the PWA state engineer to learn whether to apply for an allotment and how to do so.

And we urge that they do this at once.

Winter Work on Public Improvements

Unemployment relief is more necessary in winter than in summer, but many officials appear to think that public works construction must stop when freezing weather comes. As a matter of fact, most work can be done as well then as in summer, if proper precautions and measures be taken, although the cost may be somewhat greater. But the extra cost will be much less than that of supporting the unemployed without giving them work to do.

Experienced concrete constructors know how to carry on concrete work at all temperatures. Rock work is not interfered with by cold, and earth work very little. As for sewer and water pipe laying, below a depth of four or five feet the cold has little effect. The writer has laid sewers when the temperature did not rise above 10° for days at a time; even ground water standing in a 6-foot trench did not freeze over-night. Almost the only additional precautions necessary were to prevent frozen lumps of backfilling from falling onto the pipe (returning excavated material onto completed sewer at once eliminated this danger); wetting down the back-fill to thaw frozen lumps where there were any; and having the pipes clean and below freezing before making the joints. If the top foot or two of the trench is frozen hard, an air compressor and drill can be used to sink a line of holes along each side of the trench, and the top be removed with a crane bucket or broken up by sledges.

A little ingenuity or experience, and especially a *will* to do the work, will make it possible to carry on almost any outdoor work throughout the entire winter.

Developments in Sewage Treatment

According to a leading sanitary engineer (see page 15) the outstanding features of sewage treatment development during the past year have been revival of interest in chemical precipitation, development of more direct methods for handling sludge, and improvements in mechanical equipment.

As to the last, readers of PUBLIC WORKS have been given complete information through its articles "Mechanical Equipment in Sewage Treatment"; and on the other two subjects also we have endeavored to keep them informed on the latest developments. The articles referred to have given much information concerning the handling of sludge by screening, vacuum filtering, incinerating and other methods of direct disposal.

A summary of the recent advances in chemical treatment of sewage and sludge, given in this issue (page 20), sums up very briefly the principal features of thirteen types of chemical treatment and results obtained by them: the author including under the term "chemicals" paper pulp, marl and other insoluble materials applied for their physical effect. Unfortunately, the author gives no cost figures of these several processes except that one cost considerably over $100 per million gallons, exclusive of capital charges.

Recent developments all seem to indicate that reliance on bacteria for sewage disposal is being replaced by more direct, controlable and rapid chemical and physical treatments.

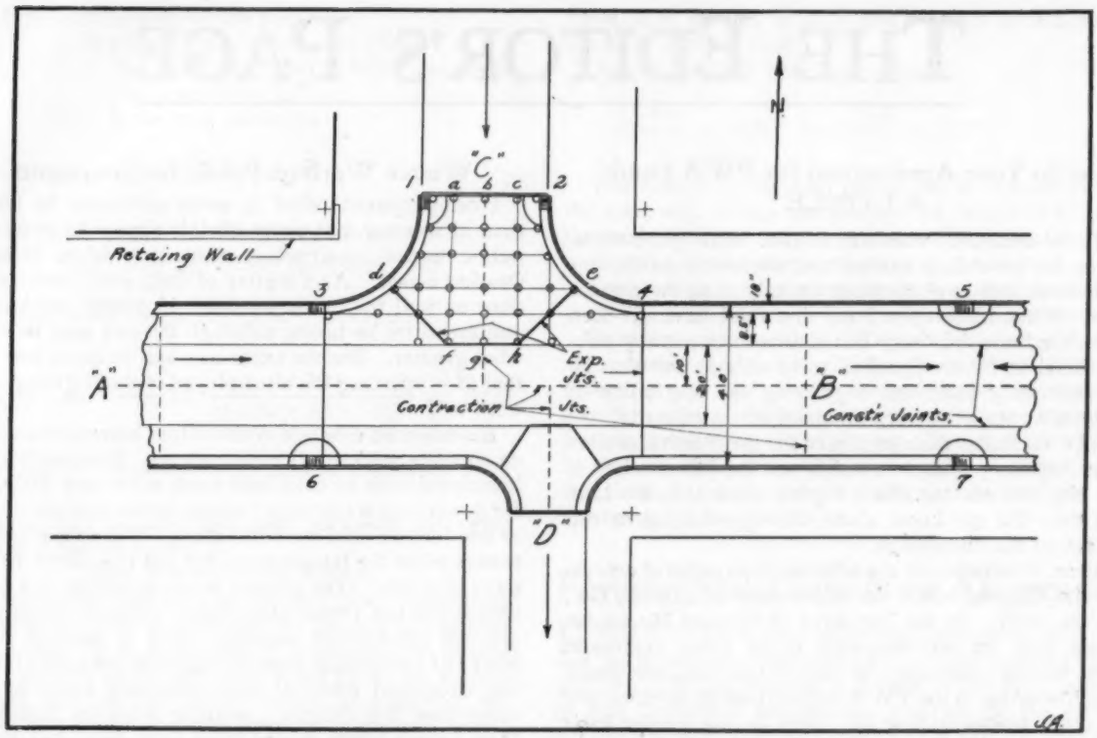


Diagram illustrating method of staking out a street intersection.

Laying Out and Staking a Street Intersection

By John Arneson
City Engineer, Fergus Falls, Minn.

THE following method was used in staking out the street intersections on a paving job completed here last seascn:

The combined curb and gutter were built first. The State Highway Department then built the center 20 ft. portion. The sides and intersections were then filled in by the city.

Referring to the drawing of a portion of the pavement and one of the intersections, the pavement "A," "B" is the route of the highway. Since this street carries the main traffic, preference was given to this street as to grade in designing the intersection.

At all points along the highway the curbs and gutters are at equal elevations as to sides. The grade is such that there is about one foot difference in elevation between points 3 and 4. In general the ground slopes to the southeast, so a rather deep cut was made at one block corner and a retaining wall built. The street to the north rises quite abruptly and the point 1 is one foot higher than 3, and ½ foot higher than 2, and 2 is 1½ feet higher than 4. The elevations of these four points were decided on so as to harmonize with the present grounds and in connection with future street paving to the north.

The next step was to so stake and shape the intersection that it would drain properly and ride smoothly. Because of the difference in elevation between points 1 and 2, the crown was shifted from b to a. Doing this provided a banked turn for a driver going west on the highway and turning north, and there is also a crowned turn for the other side. The traffic on the main highway goes through very smoothly because the center 20 ft. portion was held to grade.

As mentioned before, the center portion and the curbs were in place. Short pieces of reinforcing rods were then driven at the points marked with a circle. Chalk lines were stretched along these stakes with a turn around each stake, indicated by the fine lines. It was then a simple matter, by sighting along these lines and use of a carpenter's level to check the slopes for drainage, to raise and lower the lines on the stakes until the desired shape was obtained. With the lines finally adjusted, it was possible to almost "see" the finished surface.

A carpenter then set the wood header from 1 to 2, trimming the top to the line. Lengths of wood 2x2's, with short pieces of 1x4's nailed to the sides, were driven from a to f, b to g and c to h, the tops conforming to the chalk lines. The expansion joint forms at d-f and h-e were also placed to the lines. The iron pins and lines were then removed, the steel laid in place and the concrete poured. The concrete was finished off to the wood guides. After the concrete had set sufficiently to support a plank, the guides were stripped and the holes filled in and the whole troweled and belted smooth.

Points 3-5-6-7 are catch basin inlets. C and D indicate side streets entering.

This method is very well adapted to those intersections that must be so shaped that no rule of setting stakes with a level will hold.

P. W. A. Officials Talk About Activities in Water and Sewage Works

MALCOLM PIRNIE, deputy administrator of the P.W.A., speaking before the American Public Health Association last month, said that construction of water and sewerage works in the United States was at the lowest ebb in August-September, 1933, despite the priority given to such projects by the Public Works Administration. The chief factor in this deplorable situation was the tax consciousness of the American public, influenced by propaganda against spending. It will be necessary to inform the public clearly, continually and decisively of the vital necessity of immediate sanitary works construction or suffer the loss of untold millions in wasteful unemployment relief measures.

The delay in approval of sanitary works is not, he claimed, all due to Washington PWA offices; a larger part than is commonly known is due to legal and financial difficulties and to the general public apathy in local communities. At present 125 million dollars of water and sewage projects have been approved by the PWA, of which little is as yet under construction. Estimates of the PWA indicate as much as one billion dollars of prospective water and sewage works construction in the coming year. If the PWA funds available are not allotted before January 1, 1934, for non-Federal projects it is likely the money will be spent on Federal projects. Mr. Pirnie is now at work developing construction codes, particularly the labor wage rates. It was indicated that the present labor rates in various sections of the country, with slight increases, may be incorporated as minimum rates into industrial construction codes with provision for automatic increases up to 50 per cent over the minimum rate by September 1, 1934.

Abel Wolman, special representative of the PWA, speaking at the same meeting, stated that as yet no cities have received actual cash in connection with their PWA projects which have been approved. Some well-prepared projects have been approved at Washington in five days where grants alone were involved. It has been estimated that where labor rates are from 22½ cents per hour up and involve as much as 50 per cent of the cost of the project, it is to the best interests of the community to take advantage of the PWA grant.

PWA Activities in Ohio

F. H. Waring, speaking of the PWA activities in Ohio, stated that the governor in March, 1933, appointed a Work Project Development Committee of 19 members representing business and public works, including the State Sanitary Engineer, and a special representative was sent to Washington to keep the state informed of the latest national developments in these matters. According to state health department records, the expenditures on sanitary works in 1930 were 12 million dollars; in 1931, 8 million; and in 1932, less than 3 million, where the annual average had been 15 million, and at the request of the committee, the State Department of Health detailed six of its sanitary engineers, beginning April 15, to inform cities of the necessity of immediate sanitary works improvements to relieve unemployment, and to assist them in their local programs.

These engineers, who were paid from the department budget, visited 250 cities by July 31, working as in an extraordinary emergency situation. As a result, 165 applications for $37,500,000 of sanitary projects were received from 106 cities and 6 counties, and 76 applications for $18,000,000 of projects were in preparation. Close personal contact with city officials in this field survey eliminated many mistakes and speeded up the preparation of plans. Incidentally, when the budgets of state departments were reduced recently, that of the Department of Health was untouched.

When the PWA began to function, the work of the Work Project Development Committee was turned over to the State PWA, and the State Department of Health furnished office help and space to the PWA engineer. Efforts were concentrated on 15 sanitary projects at first, with the result that many of these, including works at Cincinnati, were approved among the first by the PWA at Washington. On October 1, the status of the PWA sanitary projects in Ohio was as follows:

No.	No. of Cities	No. of Counties	Cost (Million Dollars)	Approved by State PWA	Cost of Approved Projects (Million Dollars)
150	76	2	39.4	27	21.9
94	55	4	16.7	(under preparation)	

Of the 27 approved projects, 8 involving $13,000,000 have been approved by the Washington PWA. Of the 150 projects, new water works systems for 28 cities involve $1,286,000; extensions to water works systems for 15 cities and 1 county involve $6,175,000; new water purification plants for 11 cities, $8,637,000; new sewerage systems for 50 cities and 1 county, $380,000; extensions to sewerage systems for 16 cities and 2 counties, $7,500,000; and new sewage treatment plants for 10 cities, $14,500,000. Of these projects, 74 involving $18,458,000 were to be paid by general obligation bonds in present statutory and tax limits where no vote of the electorate was required; 5 to be paid by bonds previously authorized and voted on for $7,500,000; 50 from 14 cities by general obligation bonds outside board and tax limits by special acts of the legislature, involving $12,900,000, and requiring a majority vote; 18 from 14 cities and 4 counties by assessment bonds involving $2,000,000; 96 from 86 cities by revenue bonds, no vote required, $7,000,000; one by special lease plan (government construction, installment purchase) for one city, $8,000,000; and one by canal rentals, $142,000.

FRA and Sanitary Works

In January and February, 1933, Dallas employed 40 men working 3 days each on a stagger system to survey the sewerage facilities of homes and then to push a program for installing privies by an educational campaign. Because this was considered work on private property, the Federal Relief Administration withheld approval and funds. Now, under a new relief program, this work

(*Continued on page 47*)

HONOR ROLL

BRIDGEPORT	LYNN
DES MOINES	MILWAUKEE
ELIZABETH	NEW BEDFORD
FALL RIVER	SOMERVILLE
GRAND RAPIDS	SOUTH BEND
KANSAS CITY, KAS.	TULSA
LONG BEACH	WATERBURY

NO TYPHOID MORTALITY IN 1932

Decreasing Typhoid in Our Large Cities

By James A. Tobey, Dr. P. H.

THE urban typhoid rate of 1932 was the lowest in our history. No deaths from this disease occurred in fourteen of the largest cities in the United States; in 58 other cities the typhoid mortality rate was less than 2 per 100,000 population; and in ten of these cities the only typhoid deaths were of non-residents who were brought to hospitals within the various city limits. In the 93 largest cities the combined mortality was only 1.34 per 100,000. During this year there were only 508 deaths from typhoid out of a population of nearly 38,000,000 in these cities, and this result was achieved in spite of a flare-up of typhoid in certain parts of the country last summer. Even the cities in our southern states, where typhoid is usually most prevalent, showed a definite reduction in deaths from the disease.

This achievement is all the more impressive when the present figures are compared with those of the past. In 1910, for example, the typhoid mortality in 78 cities was 20.54 per 100,000, or about twenty times as great as in the same cities in 1932. A decade ago the rate was three times what it is now and in 1931 was nearly 25 per cent higher than in the following year.

Although the methods for the practical control of typhoid fever have been understood for thirty years or more, no city was free from typhoid deaths until 1919, when Yonkers, N. Y., and Spokane, Wash., were able to report no mortality from this preventable cause. Since that time about forty cities have had no deaths from typhoid in various years and many of them have been consistent repeaters in this enviable record.

The fourteen cities on the honor roll because of their freedom from typhoid mortality in 1932 include:

Bridgeport	Kansas City, Kan.	Somerville
Des Moines	Long Beach	South Bend
Elizabeth	Lynn	Tulsa
Fall River	Milwaukee	Waterbury
Grand Rapids	New Bedford	

Among the cities with rates less than 2 per 100,000 which would have had zero rates but for non-resident deaths are Rochester, Syracuse, Hartford, Jersey City, San Diego, Albany, Trenton, Duluth, Scranton, and Springfield.

Only eight large cities had typhoid death rates in excess of 5 per 100,000 in 1932. Those, and their rates, were:

El Paso	5.6	Knoxville	8.0
Dallas	7.4	New Orleans	8.6
Nashville	7.6	Atlanta	8.8
Chattanooga	8.0	Memphis	11.4

In fairness to El Paso, Nashville, Knoxville, and Memphis, however, it should be stated that one-third or more of the typhoid deaths in these cities are claimed to have been among non-residents. Even so, the rates are too high. Nashville and Memphis have divided the odium of possessing the highest typhoid rates during most of the years since 1910.

For many years the New England cities and those in the East North Central part of the country have shown the best records, with the Middle Atlantic and Pacific groups close behind. The southern cities have consistently displayed higher rates, although the cities in the South Atlantic section achieved the greatest reductions in 1932.

These differences may be due in part to climatic conditions and to the presence of certain racial groups in the South, but they are also due in large measure to the quality of public health activities. That southern cities can eradicate typhoid is shown by the example of Tulsa, with no death in 1932, and Baltimore, with a rate of 0.6, Norfolk with 0.8, and Miami with 1.8.

In spite of large colored populations, much poverty, and adverse climatic conditions, there is no reason why all cities in the South should not have much lower typhoid death rates. Much has been accomplished in recent years and more can be. Nashville, for example, had a rate of 40.2 in the period from 1911 to 1915, but only 7.6 in 1932. Memphis was even worse in the five years from 1911 to 1915, but reduced its rate to 4.7 in 1930, although the figure rose to 11.4 in 1932.

If the typhoid fever death rate of 1910 still prevailed in this country, there would have been about 7,800 deaths in the 93 largest cities instead of only about 500. In other words, the lives of 7,300 persons have been preserved by sanitation. In dollars and cents, this means a saving of at least seventy-five millions of dollars. Perhaps the figure should be much higher in spite of the lowered values of depression times.

THE WATER WHEEL

FOLLOWING are the essential features of the important articles of the month having to do with water works design, construction and operation and water purification, arranged in easy reference form and condensed and interpreted. Published every month to include articles appearing during the preceding month.

SEDIMENTATION should receive more attention than it does. Mr. Gibson,[12] if he "had to select between the filter or sedimentation basin, would certainly select the sedimentation basin"; while Mr. Slocum believes that it is in sedimentation "that water purification should substantially be accomplished. The subsequent filtration, the after addition of such chemicals as chlorine and ammonia, should be finishing touches, not main dependencies for the safety of the finished effluent."

"The real purpose of rapid sand filtration is to remove turbidity, odor, taste and color from water. It is not to remove bacteria, although the process actually does remove a large proportion of those present.[8] . . . If the filters remove practically all of the turbidity, odor, taste and color from the water, they have done all that should be expected of them and any further sterilization that may be necessary should be accomplished by other means."

Filter designing.[8] If the number of filter units is too small, there results a lack of flexibility in small plants and excessive cost of wash water system in large plants; while too many units will increase the cost of both construction and operation. The suitable number$=2.7\sqrt{P}$, in which P is the total nominal capacity of the plant in million gallons per day.

"There is available to engineers practically no information as to what effect size of sand has on clogging rate" (rate at which the loss of head increases, in inches per hour of operation). "To what depth the sand size affects the rate of clogging is not known," nor is the effect on purification of sand size at different depths.

Gate valves in filters are subjected to a tremendous amount of use as compared with those in the distribution system, and should be selected with this in mind.

Filter maintenance.[8] To maintain sand in good condition requires an expansion of at least 50% when washing. The illustration shows a very simple device for measuring sand expansion, consisting essentially of a submarine light on a graduated rod. "Comparisons made over a long period of time have definitely established the fact that the effluent from a filter containing clean sand is superior to the effluent from a filter having side wall accumulations or in which the sand is coated."

Prechlorination of water as it leaves the settling basins in Richmond,[9] 10 to 20 lbs. per million gallons, sterilizes it before it reaches the filters, "thus reducing the organic loading and relieving the filters of the responsibility of bacterial reduction"; is of great assistance in coagulation; and stabilizes the material deposited in the coagulated-water settling basins. However

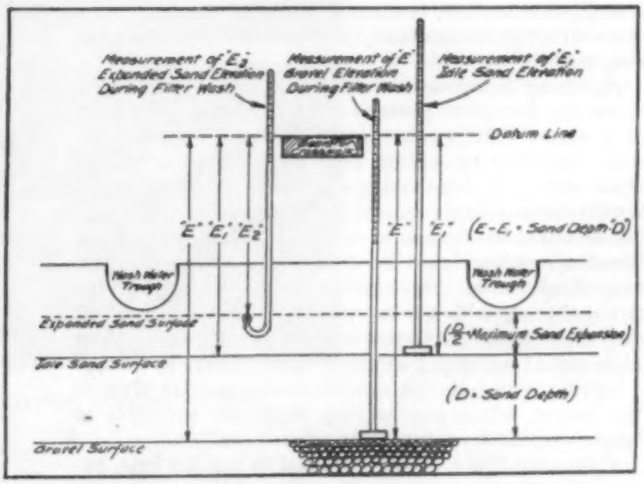
"*Activated carbon* will stabilize these materials over a greater range in time and putrescibility than will prechlorination[9]." Carbon is used also to remove objectionable tastes and odors. Richmond has "found that, within limits, when water is filtered through the carbon rather than the carbon mixed in the water, only about one-tenth as much is required for the same taste/odor removal. . . . Recent tests prove that the most economical method of obtaining this filtering through the carbon is by coating the filter with the necessary quantity at the beginning of a run, adding more if required later in the run." Close study at Richmond has conclusively proven that "the carbon feed should be so arranged that controlled quantities may be applied either onto the filters or before with the coagulant, or both," and "an accurate study of conditions at each plant and under different water conditions must be made to determine the most economical quantities and place of application."

Copper sulphate is used in the Richmond settling basins to control organic growths, and "a marked improvement in the control of growths has been obtained with even less use of this chemical by continuing the treatment during winter months rather than waiting for growths to appear."[9]

If more than 0.2 p.p.m. of copper is present in the water delivered to consumers it would be dangerous, but more than this can be applied, for "at least some of the copper salt will be flocced out with the alum treatment and consequently be retained on the filters."[10] Preliminary investigations indicate that "it can be safely stated that under the ordinary operating conditions where a neutral water is treated with about 0.5 g.p.g. of alum and about 0.2 p.p.m. of copper sulfate there will be an almost complete removal of the copper salt in the water treatment plant."

Softening by the excess lime method, with soda ash to remove permanent hardness, would seem to be the most logical method for the Pacific Coast,[36] because there "soda ash is cheaper than in the east, being produced in Owens Valley, while zeolite is cheaper in the east." Findlay, O., uses lime to remove temporary hardness and zeolite for permanent hardness.

Ammonia salts are relatively unstable compounds.[11] The carbonate when exposed to air disappears as ammonia, carbon dioxide and water. The sulphate is the most stable. Under very humid conditions it absorbs some moisture and forms lumps, but if to be fed dry,



Device for measuring sand expansion.

these can be broken easily by passing through an eighth inch screen. It corrodes iron, copper, monel metal and brass, although the last can be used for connections. Rubber hose is convenient for applying the solution. It may be purchased in 100-pound sacks at prices ranging from 1½ to 2 cents a pound, with approximately 25% ammonia content, thus costing about 7 cts. per pound of anhydrous ammonia.

Ammonium sulphate is commonly prepared from ammoniacal liquor of gas works and retort coke ovens, but Richmond obtains a very pure sulphate prepared by the atmospheric nitrogen process, free from cyanides, pyridine and other undesirable impurities. Germany manufactures great quantities of this. Possibly the Muscle Shoals plant may do so.

Elevated storage tanks were studied for Sheyboygan's water supply,[70] to furnish 4 m.g. storage, or 30% of the maximum daily pumpage, between elevations of 180 and 200, where the ground elevation was 153. Five different designs were studied: 1—A reinforced concrete reservoir 47 feet deep. (Difficult to make tight, and expensive). 2—Steel standpipe 185′ diameter by 47′ high. (Steel plates impracticably thick; very expensive). 3—Raising ground to 180 El. and building thereon a Hewett type reservoir. (This type in such large size, experimental; cost high). 4—Elevated steel tank 185′ diameter x 20′ high on steel columns. (Appearance objectionable; cost high). 5—Steel tank 185′ diameter x 20′ high, resting on flat concrete slab supported by 28 concrete piers and 42 columns, and surrounded by a brick wall 3′ from it and also resting on the slab; the whole designed with a view to architectural effect. Bids were received on numbers 4 and 5, and those for the latter were about 30% less than for No. 4 and it was preferred for other reasons, and was built for $64,343. Concrete was contracted at $7.90 per cu. yd. for footings, $8.40 for girders and floor slab, and $8.90 for columns, with $1.50 extra for winter concrete.

Draining a reservoir in which no blow-off pipe had been laid, was accomplished in Augusta, Me., by means of a siphon.[59] This, 222′ long, was laid of 6″ b. & s. pipe from a sump in the reservoir, on the bottom and up the bank, across its top and down the outside. A valve at the outlet could be closed, water pumped into the siphon through an opening at the top of the bank by a small boiler feed pump, this opening closed and the outlet opened. A part of the siphon just above and below the ordinary water level was constructed of a section with flanged ends which could be removed when not in use. All joints in the siphon, which had been made with Hydrolite, have remained air tight, although subjected to temperatures from 20°F. to 100° while the pipe was empty.

Pumping equipment obsolescence causes increased operating cost more pronouncedly than any other part of a plant.[13] It is now practicable and a financially sound practice to replace even relatively new equipment with centrifugal pumps of the latest design with resultant remarkable reductions in the cost of pumping. Numerous instances can be cited in which the new pump installations have paid for themselves during the first year of operation. Jacksonville, Texas, replaced a centrifugal pump with a new one costing $950.62 installed and saved $1395.90 in power costs the first year. "The high cost of operating obsolete equipment is in the aggregate greater in the smaller municipalities than in the larger, where engineering staffs are available to keep close check on operating efficiencies."

Cotton caulking yarn, developed to replace jute, expands very much more than jute when wet. In Atlanta,[17] joints made with cotton, before any lead was poured, took up 75 per cent of the leakage in 15 minutes, and later withstood a hydrostatic test of 300 pounds without leaking—the cotton alone.

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(Continued on page 43)

Moisture-Film "Cured" Macadams

By C. A. Hogentogler, Jr.,
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THE scientific principle of stabilization by water film cohesion applied during the curing and seasoning period is now suggested for furnishing newly constructed macadams with the high stability possessed by relatively thin old traffic-bound roads and macadams, but which has, disappointingly, failed to materialize in many of the newer rolled stone bases especially constructed for bituminous surface treatments or for brick or bituminous wearing courses.

Unless a macadam is properly seasoned by traffic after rolling, there results (1) Increased expense for maintaining when subjected to direct action of traffic and the elements; (2) Inferiority as a foundation, and therefore (3) the gradual elimination of a road type which, when properly constructed, is an economic asset in any highway program.

Many examples can be cited which demonstrate the high supporting value and stability of seasoned crushed rock, slag and similar road surfaces. In constructing the Connecticut Avenue experimental road in 1911, seven bituminous macadam sections of the penetration type were laid on existing water-bound macadam 5½" thick. The total cost of construction and of maintenance up to 1928 ranged from 89 cts. to $1.15 per square yard, and although the pavement had carried very severe traffic for 16 years, they were all "in serviceable condition" in 1928, according to the Bureau of Public Roads, "and, with continued careful maintenance, should not require reconstruction for some years to come."

The Bureau also, in 1929, stated that the Bradley Lane experimental road, a limestone macadam road 3,800 ft. long, was surfaced with various materials between 1911 and 1915, and although after the latter year the traffic increased to ten times the previous volume, the macadam had, up to that time, proved sufficiently stable to support the increased traffic.

Nevertheless, the "rolled stone base" has generally failed to give the high stability at low cost which these experiences seemed to warrant anticipating. Also extensive patching of pot holes and soft spots has often followed surface treating of newly constructed water-bound macadam. This is found to be due to failure properly to "cure" the macadam. The curing or seasoning of a macadam surface under traffic and climatic influences for periods of time required to furnish the necessary compactness, bond, etc., is far more important than the rolling; in fact, these can not be secured without curing, no matter how thorough the rolling.

In the Proceedings of the Seventh Annual Meeting of the Highway Research Board, it was stated, concerning surface treatments on water-bound macadam: "When these were applied within a short time after thorough compaction by rolling, there was often a tendency to crack off, thus indicating that further compaction was occurring underneath. When, however, the surface accommodated traffic throughout the winter before receiving surface treatments, slightly less bituminous material was required for the first coating and no cracking off occurred." The same facts were brought out by the Bates tests and practical road experience in Ohio.

Proper seasoning requires not only traffic, but also moisture. If the surface is permitted to dry, pot holes or ravelling occur in isolated areas, which may disturb the original homogeneity of the surface to such an extent that, even though repaired, they cause roughness, extensive patching and other defects resulting in premature failure as well as high maintenance cost. Maintaining the surface in a damp or slightly moist condition utilizes the cohesive moisture films in the minute pores of the binder to prevent ravelling, while the blows of traffic gradually wedge the crushed angular fragments into closer association, with the moisture film cohesion increasing as the pores of the mineral binder become smaller, until there is complete consolidation of rock fragments, screenings, filler and moisture film. Therefore, any agency capable of introducing and maintaining moisture films in the minute pores of seasoning macadam is of the greatest advantage, physically and financially.

Water in amount sufficient to keep the top surface of new macadam continuously moist is not generally available at road sites; and, if available and applied, would tend to so soften both road surface and subgrade as to threaten the total failure of the pavement structurally. Highway research has shown that the desired condition can be maintained by incorporating in the macadam a deliquescent material.

Part of Bradley Lane Experimental Road

Part of Connecticut Ave. Experimental Road

The researches of Fred Burggraf[1], of W. R. Collings and L. C. Stewart[2], and of H. F. Clemmer[3] clearly demonstrate that calcium chloride is admirably adapted to furnish the desired hygroscopic properties, absorbing moisture from the air as well as retaining the proper amount of that furnished by sprinkling.

The following principal features essential to the construction of stable, durable, macadam, listed in "Proceedings of the Sixth Annual Convention of the Association of Highway Officials of the North Atlantic States," pages 65 to 78 inclusive, and supplemented to include the use of calcium chloride, are as follows:

1. Installation of drains to intercept seepage, to properly dispose of surface water, and to drain the subgrade at all sags.
2. Smoothing off and consolidating the subgrade by rolling and constructing sides of trench to receive the crushed stone or slag course.
3. On all subgrades except the sands, the sand-clays, and gravels of the A-1, A-2, and A-3 subgrade groups, the constructing of a thin cushion layer of either crushed stone dust or granulated slag.
4. Consolidating the cushion layer by rolling and sprinkling with water containing enough calcium chloride in solution to make an application of about ½ lb. per square yard, or application of similar amount in flake form.
5. Spreading the crushed rock or slag to the desired thickness by means of properly sized block gauges and thoroughly consolidating.
6. Completing the rolling operation by alternately spreading the screenings, sprinkling, and rolling until a grout forms ahead of the roller wheels.
7. Adding enough calcium chloride with the water during the last of the sprinkling and rolling operation, or applying in flake form, to afford the application of this chemical on the completely rolled surface at the rate of 1 lb. per square yard.
8. Covering the road with about ½ inch of screenings, and opening to traffic about 12 hours after completion of the rolling operation.
9. Watching the road surface carefully to see that the proper degree of stabilizing moisture is maintained, and sprinkling or adding small amounts of calcium chloride or screenings as required.
10. Continuing this intensive "curing" operation until a sufficient amount of traffic has been accommodated to completely consolidate the surface with the complete elimination of the possibility of future ravelling. This may require from several weeks to several months, depending upon the traffic intensity. In addition, the curing period should include several heavy precipitations, being extended for this purpose when necessary.

Based on his experience with calcium chloride on newly constructed macadams in Ohio, Q. A. Campbell* cautions against the formation of hard crusts of chloride and stone screenings on the surface of such roads. In contrast to the binder of untreated macadams which, in dry weather, may become dusty enough to be easily broomed from the stone course, the removal of formations of binder treated with calcium chloride may require the use of a mattock. Such crusts, of course, may occur in all macadams under particular moisture conditions. To prevent these crusts from forming on the surface and to utilize their hardness for stabilizing the body of the slab, the screening layer should be maintained as thin as possible and every effort should be made to have the chloride incorporated within the coarse stone layer.

More than ever there is need of a type of road of relatively low cost which will furnish high-type service; and macadam constructed as described above would seem to commend itself to every engineer and administrator desiring efficient transportation service for low total cost.

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2. Bulletin No. 36, American Road Builders' Association.
3. Reported in the current engineering press.

*National Paving Brick Manufacturers' Association, Washington, D. C. Formerly with the Ohio State Highway Dept.

Low-Cost Roads in the North Atlantic States

At this year's convention of the Association of Highway Officials of the North Atlantic States, much of the discussion was devoted to low-cost roads. These included gravel, penetration macadam, re-tread, mixed-in-place, light bituminous macadam surfacing over gravel, tar surfacing, and others. An abstract of the salient points is given below.

Gravel Roads

Edward E. Reed, assistant state highway engineer of New Jersey, said that "Gravel roads that have not been treated are unsatisfactory in both wet and dry weather. They are in their best condition when moist. It is, therefore, necessary to give them a surface treatment of some kind." New Jersey has used for this purpose calcium chloride, asphalt emulsion, lignin binder, slow curing oil, heavy cut-back asphalt, tar, and tar on slow-curing oil.

The first two have not been used extensively in New Jersey. Lignin binder costs $528 per mile, four applications, for an 18 to 20-foot road. Slow-curing oil costs $650 to $900 per mile for two applications on untreated road, or $325 to $450 for re-treatment work. Heavy cut-back asphalt, used on roads previously treated with slow-curing oil, costs $1600 to $2000 per mile. Tar costs, for two treatments on a road not previously treated, $3200 to $3600 a mile; for one application on a road which has been treated, $1700 to $2700.

Gravel roads treated with calcium chloride in Onondaga County, New York, were described by R. B. Traver. An article on the subject is given elsewhere in this issue.

C. B. Bryant, materials engineer, Maryland State Roads Commission, stated that the most of the low-cost road construction in that state was confined to run-of-bank gravel which is "economical in first cost and moderate in maintenance." The subgrade is covered with this gravel 5 to 7½ inches thick, consolidated by dragging and traffic. Deficiencies in fines and clays are made up; gravels containing an excess of these cannot be used successfully. When this has been well consolidated, a 4 inch (loose) thickness of the same gravel is treated in the same way, and compacted by traffic until the next spring, being intensively maintained by frequent dragging meantime.

The next season a power-driven road machine removes all high spots, corrugations or loose material and remaining loose material and dust are swept off. It is then treated with ½ gal. per sq. yd. of a medium curing asphalt primer (Furol viscosity 80 to 150 at 77° F.) or a tar primer (Engler specific viscosity 8 to 13 at 40° C.), which a few minutes later is covered with 20 lbs. of loose material which had been bladed off, cast on by hand, 20 men covering 1½ to 2½ miles per day. When this has cured (a week to a month later) a second similar treatment is given but using ¼ gal. From one to three years later, when the road first begins to ravel, it receives a final treatment with a heavy chip-holding grade of asphalt or tar, ¼ to 1/3 gal., and 30 to 50 lbs. of stone or slag chips.

Maryland has 650 miles of such roads, which cost from $1,300 to $1,900 per mile of 16 ft. road, not including grading or drainage, for the first treatment, and $750 for the double surface treatment next year, and $480 for the final treatment, a total cost of $2,600 to $3,000.

Re-treads and Mixed-In-Place

E. C. Lawton, deputy commissioner on construction, Division of Highways, New York State, told of practice in his state, where retread "consists of machine mixing of coarse aggregate with suitable bituminous materials, the mixing being done on the road as the work progresses rather than at a central mixing plant."

A 2-in. retread cannot be depended on to carry heavy loads unless placed on a firm and stable foundation. In New York, most of it is placed on old macadam; a little on gravel shaped up with a hone or grader, rolled, and given a surface treatment of 1/3 gal. of tar per square yard.

The stone used is a dense mixture of equal parts of 5/8" to 1" and 1" to 1⅞". After this has been spread and leveled, tar 25 to 45 viscosity is used for first coat, 0.5 gal. per square yard, and mixed with a blade grader, spike-tooth or disc harrow, orchard grader, pin machine, or mixer of the hone type. Then a second application of tar, 45 to 65 viscosity, 0.5 gal. per square yard, is applied and mixed until all stones are completely coated, and the material is windrowed along the edge of the road and allowed to set for a day or two until "tacky," then spread by a grader of long wheel-base (the long base to give a smooth riding surface).

Where asphalt emulsion is used instead of tar, a slow-breaking type (about 2½ hours) is used for a first coat and a 30-minute emulsion for the second coat. The first application is 1 gallon, mixed as for tar, but the mixing must not be continued too long. The stone is then spread at once, surfaced, coated with stone chips, rolled and broom dragged; and then the second application made, 0.6 gal. per square yard, the surface chinked and rolled.

Where asphalt cutback is used, a range of viscosity between 50 and 200 is selected according to the temperature. The procedure is the same as for tar. A total of 1.2 gals. is used in two or three equal applications, with additional 0.3 gal. for a seal coat.

The average cost per mile of 474 miles of retread built in 1932 was: Bituminous material, $1,407; stone, $2,367; labor on pavement, $655; total, $4,429.

H. E. Sargent, commissioner, Dept. of Highways, Vermont, said his state in 1932 built 109 miles of mixed-in-place road, at a cost of about $4,600 per mile where gravel is used 2" thick, and $5,600 for stone 2½" thick. Experience with mixed-in-place pavements had proved to them that a slightly lean mix is more stable under traffic immediately after construction, and a tight seal is necessary to withstand Vermont's spring conditions.

"The quality of the sand used in the mix is more important than that of the coarse material. It should be clean and as free from fine material as possible. The coarser it is, the better the results." On the larger jobs it is better to separate the sand and stone and remix them with 20% to 30% sand, or even 50% if the sand is very coarse.

A prime coat of bituminous material on the base as soon as it is built eliminates dust nuisance to traffic, hold the base in place, prevents intrusion into the mix of undesirable base materials, provides a true and smooth base and helps keep capillary moisture from working up into the surface. "Our practice is to use tar with gravel, and cut-back asphalt with crushed stone." The application of the seal coat is delayed as long as practicable; the amount needed can then be determined better. The rule of 0.5 gal. of tar per sq. yd. for each inch of thickness of the compacted road is "surprisingly accurate."

"In building crushed stone surfaces, we prefer mixed-in-place to penetration, even when 2½" stone is

used. It is cheaper, faster to lay, and makes a much smoother riding road." "The maintenance cost is less than for surface treated roads, retreatment in 1932 averaging about $425 per mile of mixed-in-place road."

Penetration Macadam

R. W. Coburn, construction engineer, Massachusetts Dept. of Public Works, said that "this type of construction, more commonly called bituminous macadam, has always been very popular in Massachusetts on account of its moderate construction cost and its low maintenance cost." He considers it a modern high-type pavement, with "a wide field for use wherever trap rock or other suitable stone is available." He described the type developed in Massachusetts in 1912, which is well known and of which there are 922 miles on the state highway system—more than all other types combined. On the basis of 1932 prices these cost $9,000 to $12,000 a mile, the latter including a 10" stone fill foundation; and $100 to $175 per mile per year for maintenance, carrying 6,000 to 12,000 vehicles per day.

Interesting just now is his statement: "The amount of machinery and equipment necessary for this work is probably smaller than for any other type of modern pavement." Except for hauling the stone and spraying the bituminous material, "about the only machinery needed on the job is the steam roller." For materials, experience has shown that the top should be of stone with a French coefficient of at least 14 and toughness at least 12; although it may pay to use local stone of 12 and 10 on secondary roads. Coefficients of 8 and 8 may be used for the base course.

For bituminous material, satisfaction is given by either A—Fluxed native lake asphalts with a penetration of 120 to 150. B—Oil asphalts with a penetration of 85 to 120. C—Tars with a consistency of 120 to 180 by the float test.

His design for low-cost construction would be 18 ft. of 2½" asphalt penetration, with 3 ft. gravel shoulders, on a foundation of 10" of bank gravel or a combination of 3" of bank gravel and 8" of stone fill. This would cost, by 1932 contract prices, from $6,000 to $8,600, including only the surfacing and about 7" of excavation therefor.

Emulsified Asphalt Penetration

Ernest L. Merrill, assistant engineer, Maine State Highway Department, described the type of surfacing found very satisfactory in Maine for roads "where the traffic census shows a fairly large number of vehicles per day with a small percentage of trucks." The type has been developed during the past three years. It gives "an exceptionally smooth riding, waterproof pavement that will not bleed in hot weather nor push under traffic."

These roads are built of local field stone of fairly soft granite with emulsified asphalt penetration binder, with crushed stone base omitted. "Emulsified asphalt adapts itself very readily to this type of stone since no particular harm is done if such stone breaks up some under the roller, as the asphalt will readily penetrate and coat all of the stone." Also, the Maine construction season is quite short, but with this material they can work quite late in the fall with good results.

A base is made of bank-run gravel, 12" to 18" compact depth, surface-treated with 0.5 to 0.6 gal. of tar in two applications. If possible, this base is allowed to settle under traffic until the next season. On this is spread crushed stone, 2½" to 1½" size, to give a 3" compacted depth; which is rolled until keyed together. Then one gallon of emulsified asphalt is applied, and immediately thereafter clean key stone, 1" to ½" size,

is spread uniformly, hand broomed and rolled. After this application of asphalt has had time to "break," a second one gallon per square yard is applied and at once covered with just enough key stone to fill the voids. The surface is then rolled and broom dragged; and the following day is given a thorough and systematic rolling. After at least 24 hours, a seal coat is applied; 0.3 gal. of emulsified asphalt is applied evenly, and covered with clean stone chips as soon as it breaks, then well broomed and thoroughly rolled. This is followed by a second similar seal coat before traffic is allowed on the first. This gives a granular surface, non-skid and without the objectionable rumble of an open macadam surface. If, on the last seal coat, instead of chips, crusher dust up to ¼" or coarse sand be used, a texture closely resembling sheet asphalt is obtained.

Such a pavement has been built in Maine at the following cost per sq. yd.:

Stone in place, using local field stone for crushing	$0.253
Emulsified asphalt, furnished and applied, at $0.1026 per gal.	.267
Total cost of pavement per square yard	.520

Tar Drag Treatment of Pennsylvania Roads

(Continued from page 17)

diately following the seal coat, and then allowed to remain open to traffic for two days, when it is again rolled.

This type of construction is truly a low-cost road, as only $700 to $1,800 per mile is expended on grading and drainage, even in the rugged mountain section of western Pennsylvania; $3,500 per mile in the construction of the base course; and $1,800 per mile for the wearing course; making the total cost for the project between $6,000 and $7,000 per mile.

The advantages of this type of construction are:

1. It permits the use of local aggregate.
2. It gives employment to the largest number of men.
3. It gives an extremely smooth, skid-resistant surface.
4. It permits a durable type of construction on secondary roads at minimum cost.

This type of construction is being done in District No. 11, under the supervision of H. E. Kloss, district engineer; J. L. Campbell, district maintenance engineer, and W. K. Myers, assistant engineer, who developed this type of construction.

Frazil Ice in Windsor, Ont.

Windsor, Ontario, takes its water supply from the Detroit river. During the first winter of operation, 1926-1927, and again in 1927-1928, frazil ice occasioned some inconvenience; and the most serious occurrence was in February, 1933. On this occasion, as on all others, relief was secured by placing the intake under a low pressure and blowing off the plug of ice which had formed at the bell mouth of the intake. The plant is so designed that the flow from the low-lift pumps can be utilized for this purpose.

On each occasion when frazil ice formed, the wind was west, the air temperature below 15° F., the raw water turbidity was below 30 ppm and there was no ice covering on the river for approximately 3 miles above the intake. Even though both wind and temperature be favorable, if the turbidity be 50 or 60 ppm or if the river be covered with ice, frazil ice did not form.

Producing Gas from Municipal Refuse

FOR more than two years Burnley, England, has been experimenting with the production of gas by low temperature combustion of the city's refuse. The first plant, constructed in March, 1931, had a capacity of 300 pounds of refuse per hour. Another producer, involving some changes, was tested in May, 1932; and in February, 1933, another of about four times the capacity was constructed.

It generated gas capable of providing 0.3 to 0.33 h.p. per pound of refuse, making it "two to three times as efficient as the modern destructor plant generating steam, while the cost of repairs and maintenance is considerably less than with the high-temperature process."

Bulky refuse, such as mattresses and carcases, is not treated in this plant, but only refuse passing a 6-inch bar screen, and a high-temperature incinerator to destroy these, operated by gas from the generator, would be used.

The borough engineer, Arthur Race, estimates the cost as follows (reduced to dollars at the rate of $4.60), for a plant handling 36 tons a day in the generator and another 36 tons of unscreened material from a population of 100,000. Preliminary handling and screening plant, $23,000; generators and accessory plant, $128,800; foundation work, $2,300; incinerator, $2,300; total capital cost, $156,400.

Annual cost: Interest and sinking fund, $14,361. Working costs—3 men per shift @ 26.8 cts. per hour, $6,026; maintenance $1,150; electricity, @ 1 cent per kwh., $2,162; overhead, $2,070; removal of dust and clinker @ 23 cents a ton, $3,105; total $28,874, or $1.315 per ton.

He estimates 605,000,000 cu. ft. of gas generated with a calorific value of 125 B.t.u. of which 2,000,000 would be used for incineration. The balance would produce 5,000,000 kwh. of electricity, valued at 0.2875 cent per kwh., or $14,375. This (if the gas or current were all used or sold) would leave the net cost $14,499, or $0.659 per ton.

(This net cost would be more than doubled if the labor were paid $5 for an 8-hour day.)

Laboratory Control for Water Works

In discussing this subject before the American Water Works Association, C. P. Hoover said that laboratory control for well supplies necessitates regular test for presumptive B. coli, and for residual chlorine in the treated water if it is chlorinated. The necessary routine tests for all surface water filter plants are: Quantity of water treated. Length of filter runs. Percent of wash water. uantity of chemicals used and rate. Alkalinity, turbidity and color of raw and filtered water. Residual chlorine. Total bacteria and presumptive B. coli in settled filtered and chlorinated samples.

In iron removal plants, tests for iron in the treated water.

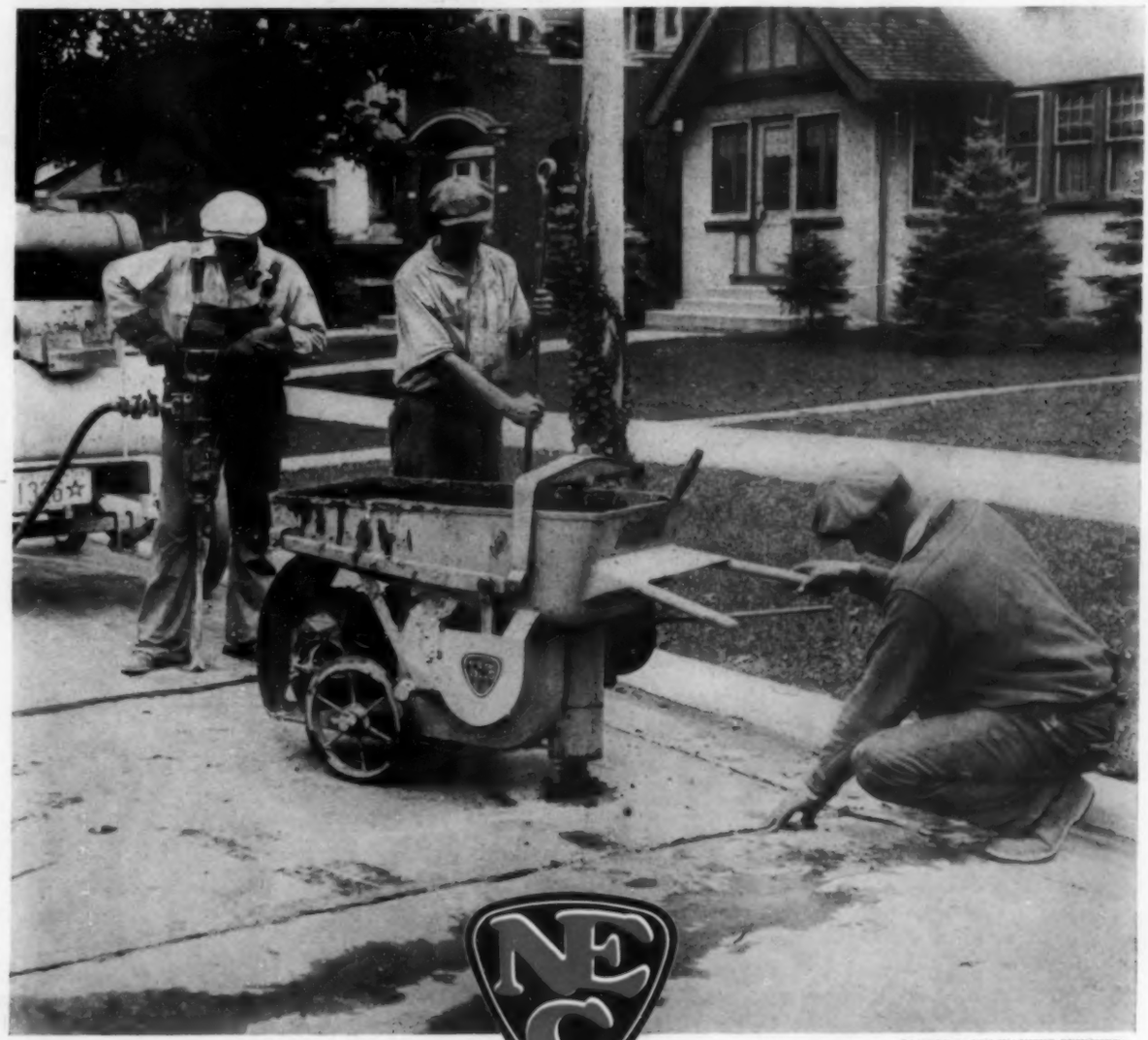
In lime or lime-soda ash softening plants, frequent tests for alkalinity (methyl orange and phenolphthalin) at outlets of first mixing tank, first carbonator and filter; for alkalinity and hardness on raw and filtered water, and hardness on first mixing tank effluent, all first mixing tank samples being heated to 50°C.

For zeolite softening plants, the soap test.

MUD-JACK

SAVE

THE CURB AND GUTTER
THE SIDEWALK « « «
THE STREET « « « « «



COURTESY MILWAUKEE SENTINEL

Maintain concrete curb—gutter—walks—streets—and all types of concrete slab—without expensive replacement costs

The N. E. C. Mud-Jack raises the concrete slab to the original grade—fills voids under slab—at a great saving in cost

METHOD

No. 10 - N. E. C.

Machine in position for raising curb and gutter

ewalk raising is ody and simple with N.E.C. Mud-Jack.

A typical and danger-ous pedestrian hazard quickly corrected with the N.E.C. Mud-Jack.

bove sidewalk de-ression raised to rade in less than ten minutes.

Protect Your Investment in Concrete Curb . . . Gutter . . . Walks . . . Streets and Miscellaneous Slab

THE Mud-Jack method of raising concrete curb, gutter, walks, and streets has solved the problem of reclaiming and correcting sunken concrete slab. It is the modern method to increase the life of concrete.

Curb, gutter, walks and streets can be raised to original grade, thereby preventing pedestrian accidents, traffic hazards—voids under the slab can be filled—to stop future depression. All of this without reconstruction—the saving accomplished pays for the machine in less than one season's operation—in addition to the protection of the original investment.

The Mud-Jack method is equally efficient for raising concrete slab of filling stations, factory floors and all types of driveways and area slab.

It is obvious that the Mud-Jack method has unlimited application in your community—that it effects a substantial saving—that it materially reduces your maintenance expenditures—yet permitting an increased maintenance program.

In addition, there is no congestion as a result of construction equipment and materials, no disturbance of traffic or routine community activities.

Preparing and correcting the subgrade is the real solution. If the base has been treated, all voids completely filled, and the subgrade compacted to prevent further erosion, the slab remains in place, will not crack or lose the grade.

To correct the subgrade for maintaining the slab at its proper location is now a very simple and economical operation. Mud, pumped through holes drilled in the slab, fills the voids and raises the project to original grade.

Two views illustrating typical curb and gutter depressions, which are corrected economically with the N.E.C. Mud-Jack. Replacement construction not necessary.

For Raising Concrete Curb-

MUD-JACK

No. 10—N. E. C. MUD-JACK

The No. 10 N.E.C. Mud-Jack, a machine developed for economical maintenance, accomplishes this work at a surprisingly low cost. The tremendous saving is obvious by comparing replacement costs with the cost of pumping mud underneath the concrete slab.

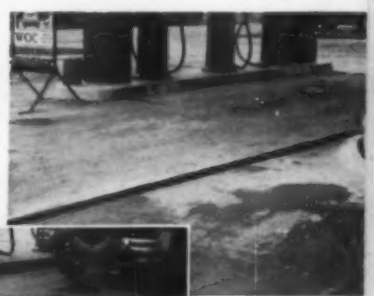
It is a small unit weighing less than 400 pounds, easily moved about the job by one man. Material required consists of a dry black top soil mixed with cement approximately 20 to 1 to take up shrinkage and set the mud. The mixture should have the consistency of thick cream or mortar. This consistency should vary, however, according to the conditions of slab, namely obstinacy of raising, end pressure, expanse of depression, and other local conditions.

The principle of operation is based upon the well known theory of hydrostatics that "pressure is exerted with equal intensity in all directions". The pressure at the 2½" nozzle directly below the pump is approximately 100 pounds per square inch. The No. 10 N.E.C. Mud-Jack is equipped with a 1¼ HP air cooled engine and has a normal capacity of approximately 1¼ cubic yards per hour, depending entirely on the supply of materials and condition of the slab.

Write for more information, citing your problems. We will be glad to offer any assistance or suggestions you may desire.

Curb and gutter depression before application of Mud-Jack method.

Above curb and gutter after elevation by the Mud-Jack method —Reconstruction cost has been saved.



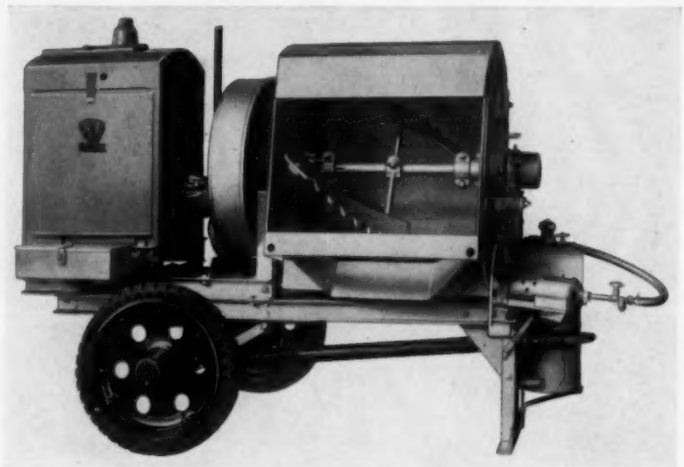
Illustrating common depression of filling station slab.

Above slab after being raised by N. E. C. Mud-Jack.

Note perfect alignment of curb and gutter after depressions varying from ½" to 3" were corrected by the N. E. C. Mud-Jack.

Gutter-Walks-Street-Slab

MODERN—ECONOMICAL MAINTENANCE EQUIPMENT



KWIK-MIX Bituminous Mixers were developed for economical maintenance of bituminous roads. Two sizes—No. 6—with capacity of 6 to 8 cubic feet and No. 10—with capacity of 10 to 12 cubic feet—give a wide range of application. Sand, pit run gravel, pea gravel, crushed rock, as well as any patented bituminous patching material—all are efficiently heated and mixed with the Kwik-Mix Bituminous Mixer. The machines can be used for patching on location, at wayside pits or for centralized plant operation.

Kwik-Mix Bituminous Mixers are equally suitable for cold or hot patch work. The saw tooth design of the adjustable manganese steel blades causes a rolling and crisscross mixing action. A detachable burner is conveniently located at the front end of the machine—opposite the engine end—for safety—an outer shell for the mixing drum—thereby indirect application of the heat to the material. Then there is no burning of the mixed material—"balling" caused by uneven heat is eliminated—no clogging—economy of binder and uniform coating of all material.

No. 50 N. E. C. MUD-JACK

CORRECTS SETTLED HIGHWAY PAVEMENTS

THE No. 50 N.E.C. Mud-Jack, a larger machine with increased capacity, is a special combination mixer and pump. It is used for correcting settlement in rigid type of highway pavement. The Mud-Jack mixes earth and water, with sufficient cement to take up the shrinkage, and then forces the mixture through holes drilled in the slab. The pressure from the pump forces the mud under the slab, causing it to rise.

With this method, the slab can be easily brought to the original grade at a very small cost. Dips from 1″ to 18″ deep are corrected with equal ease, without stopping or detouring traffic.

NATIONAL EQUIPMENT CORPORATION

Pavers • Mixers • Shovels • Cranes • Draglines • Pull Shovels • Dumpters
Backfillers • Trenchers • Mud-Jacks

Refuse Collection and Disposal in Los Angeles

Result of a comprehensive survey of the performance of ninety-eight refuse collection vehicles for a full week. Improvements and additions to equipment.

AS street improvement work decreased in Los Angeles in the latter part of 1931, the Bureau of Engineering, instead of laying off part of its staff, found other ways to use them to advantage. Sixty men were assigned to ride with the collection crews to make a detailed study of the collection of garbage and rubbish. During December a full week's study was made of the work of each crew, involving timing the movements of 960 trips and about 300,000 pickups. The data so obtained were used to revise the routes in order to eliminate overtime and undertime, to compare costs of mule team with those of truck operation, etc.

A summary of the data obtained is given in the table, in comparison with a similar survey made in February, 1919.

making them easier to load; the level full capacity is 4.8 cubic yards instead of 4.5 cubic yards and the heaped up capacity without sideboards is 8,000 pounds instead of 6,000 pounds. The flared body is easier to unload because the garbage does not cling to the corners. The rear end extends 4 inches above the sides to prevent the garbage from slopping over the rear when the truck starts.

Twenty-two new garbage collection trucks were purchased during the past fiscal year, of which ten were 3-ton, four-wheel trucks; ten were 2½-ton, six-wheel trucks; one was a 5-ton, four-wheel low-bed truck, and one was a 3½-ton tractor truck with a 10-ton low-bed semi-trailer.

The last three types are new to the department and

Average Performance of Refuse Collection Vehicles

	Refuse Survey, December, 1931			*Refuse Survey, February, 1919*	
	Garbage Collection: Teams	*Garbage Collection: Trucks*	*Can Collection: Trucks*	*Garbage Collection: Teams*	*Garbage Collection: Trucks*
Number of crews observed	18	43	37	28	3
Time to route	1:21	0:33	0:34	1:14	0:46
Miles to route	5.3	7.3	6.8	4.9	7.64
Speed to route	3.9 mi./hr.	13.2 mi./hr.	12.2 mi./hr.	3.9 mi./hr.	9.9 mi./hr.
Time from route	1:54	0:35	0:34	1:35	0:47
Miles from route	5.5	7.3	6.6	4.9	7.56
Speed from route	2.9 mi./hr.	12.4 mi./hr.	11.7 mi./hr.	3.08 mi./hr.	9.66 mi./hr.
Time on route	2:52	2:33	2:06	3:57	2:55
Miles on route	3.7	6.6	6.3 (Av. of 8 only)	..	..
Speed on route	1.3 mi./hr.	2.6 mi./hr.	3.0 mi./hr.	..	..
Pickups per load	261	359	213	333	432
Pickups per hour	91	141	102	84	148
Weight of garbage per load	4150 lbs.	5410 lbs.	†3802 lbs.	3300 lbs.	4250 lbs.
Pounds picked up per hour	1466	2120	1800	836	1456
Pounds per pickup	15.9	15.0	17.8	9.9	9.8
Pounds picked up per day	4150	11,167	†7995	3300	7540
*Cost of collection per ton	$4.82	$4.83	$6.75	$4.85	$6.10
Cost per pickup	.0383	.0362**	.0601	.0218	.0299

†Weight of rubbish taken as 325 pounds per cubic yard.
*Based on $27.00 per day for truck and crew of three men, and $10.00 per day for team driven by one man in 1931, and $23.00 and $8.00 respectively in 1919.
Night garbage collection, which is less expensive, is not included in above figures.
**Cost per pickup varies from 2 cents in the close-in districts to 8 cents in the hilly outlying districts.

During this survey, seven of the mule team routes were collected by trucks, with the following average results:

	Hours per Route	*Cost for Route*	*Tons Collected*	*Cost per Ton*	*No. of Pickups*	*Cost per Pickup*
Teams	8	$10.00	2.28	$4.38	219	$ .045
Trucks	2.65	8.95	2.08	4.30	191	.046

Letters of comment from the inspectors on the survey were almost unanimous in complimenting the collection crews on being efficient, industrious and courteous to the public. Suggestions were given for minor changes and improvements, but practically all of the inspectors stated that in general, the collection system was working smoothly and efficiently accomplishing the desired result.

Collection Equipment

Several improvements have been made in garbage collection equipment during the past year.

The garbage tanks have been changed from a vertical sided tank to a flared sided tank so that the width across the top is 20 inches greater; the depth is 4 inches less,

have not been in use long enough to determine their operating costs.

The six-wheel trucks have much smaller wheels and tires than the conventional four-wheel trucks. This gives a lower frame height and consequently a lower loading edge with a saving in labor. The two rear axles are able to carry the load, although the truck is a smaller unit throughout and of lower first cost than the conventional four-wheel truck of equal capacity. The two rear axles are trunnion mounted so that road irregularities are "smoothed out" and a higher speed may be safely maintained.

The low-bed truck is of conventional design except that the frame is only about 20 inches above the ground,

which makes it impossible to use a deep garbage tank and still have a low loading edge. A special garbage tank is used with a hump in the bottom to clear the differential, which rises about 6 inches above the frame. The tank has a capacity of 6 cubic yards level full and carries about 10,000 pounds of garbage.

The 3½-ton tractor truck hauls the low-bed semi-trailer through a fifth wheel. The frame of the semi-trailer is about 20 inches above the ground. In order to have a maximum width of garbage tank, four single tires are used on two rear axles, there being no front axle on the semi-trailer. Two large garbage tanks are mounted on the low-bed portion of the frame and a small tank is mounted on the yoke above the fifth wheel. The combined capacity of the three tanks is 10½ cubic yards level full. As much as 22,000 pounds of garbage has been brought in at one load, although the average is 18,000 pounds or less. This unit is especially valuable for the collection in remote areas where it is necessary to haul the garbage long distances to the garbage loading station. Due to disease at one of the hog ranches in an outlying community, it has been necessary for the past few months to haul the West Los Angeles garbage 15 miles into the city. With the smaller units, as much time is spent traveling to and from this district as is spent on the routes, but with the semi-trailer, the entire day is spent in collecting, except the time necessary to travel out to the collection route and back to the loading station at night. As much garbage is brought in with one load on the semi-trailer as the ordinary truck brings in with three loads.

Balloon tires have been specified for all the trucks purchased this year, but have not been in use long enough to determine their value compared with high pressure tires.

The cost of the various trucks purchased during the past year was as follows:

3½-ton tractor truck and 10-ton semi-trailer	$4349.85
5-ton low-bed truck	3200.00
3-ton trucks (conventional type)	2550.25
2½-ton six-wheel trucks	1624.00

The cost of each of the 3-ton trucks purchased was $344.75 or 12% lower than that of similar trucks purchased during the previous fiscal year.

Repairs to refuse collection trucks have been made in the past by the city's general machine shop. Considerable delay in getting repairs has been experienced at times because this shop is located a considerable distance from the garbage truck sheds and is often congested with other work. A branch repair shop is now being planned at the garbage loading station where all minor repairs to the refuse collection trucks will be made. The general shops will continue to make the major repairs and will have supervision over the branch repair shop.

The mules are now being shod exclusively with rubber shoes. This prevents sore feet due to pounding on the hard pavements and the shoes last three times as long as the iron shoes with a consequent saving in blacksmith labor. Also the mules' flying hoofs do not cut each other's legs when shod with rubber.

Incinerator

Several improvements and economies have been effected this year at the municipal incinerator. The ashes, which contain a large proportion of tin cans, are dumped in an abandoned gravel pit adjoining the incinerator, $1 per load being paid for the dumping privilege. In order to decrease the volume of the ashes, they are spread out near the bank of the pit and rolled

with a heavy roller pulled by a tractor. The tin cans are flattened and the volume of the ash decreased about 50%. The ashes are then pushed into the pit with a bulldozer bladed tractor.

A great deal of slag accumulates in the combustion chambers of the incinerator due to the metal scraps, cans, bottles, etc., that find their way in with the combustible rubbish. It has been necessary in the past to shut down the furnaces about once a month and clean out this slag. This difficulty has been largely eliminated by building a brick cribbing around the entrance to the combustion chambers. The tin cans collect in the cribbing and are raked out each night. A shut down is now necessary only about once in three months instead of once a month.

Combustible rubbish collected by private contractors is burned at the Municipal Incinerator for which a charge of $1.00 per ton is made to the private contractors. Some of the market refuse from the large vegetable markets is also incinerated.

The Municipal Incinerator was built by the Nye Odorless Crematory Company at a cost of $420,000 and put into operation in August, 1927.

All of the men employed in garbage and rubbish collection and in operating the incinerator are negroes, excepting the clerks, mechanics, foremen and superintendents. Starting May 10, 1932 these men were placed on a five-day week and additional relief men were employed where necessary.

Concreting Equipment and Methods on San Francisco-Oakland Bay Bridge

Unusual methods are being used in mixing and placing concrete for this bridge, the longest in the world, which, according to the contract, must be completed in 21 months.

In addition to a central mixing plant, there is a fleet of seven barges, each of which is equipped with material bins and with mixing equipment. These barges are 105 feet long and 34 feet wide, with eighty measured compartments for concrete aggregate. Each barge will contain two to four 3½-yard moto-mixer units, there being 21 in all, each driven by an electric motor.

For handling the concrete, each of the barges is also equipped with a complete belt conveying system, also manufactured by the Chain Belt Co. These bring aggregate from the bins to the mixers, and convey the finished concrete from the mixers in the hull to the point of placement. Enough aggregate is provided in each barge for eighty batches of concrete.

It is said that the order for equipment for the large mixer for the central plant, for the 21 moto-mixer units, and for the 28 units of conveying equipment, total to the largest single order for concrete mixing machinery placed in the United States since the construction of the Panama Canal.

The bridge is financed by the RFC as a part of the public works program for unemployment relief. It will be a double decked structure of steel and concrete, with six traffic lanes for automobiles and light trucks on the upper deck and, on the lower deck, for two interurban tracks and three lines of heavy trucks. Piers for the bridge will rise 505 feet above low water and extend 105 to 220 feet below low water, and will be topped with airplane beacons and navigation lights for marine traffic.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF MARCH 3, 1933, OF PUBLIC WORKS, published monthly at New York, N. Y., for Oct. 1, 1933.

State of New York } ss.
County of New York }

Before me, a notary public in and for the state and county aforesaid, personally appeared J. T. Morris, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the PUBLIC WORKS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the name and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Public Works Journal Corp., 310 E. 45th St., New York, N. Y.; Editor, A. Prescott Folwell, 310 E. 45th St., New York, N. Y.; Managing Editor, none; Business Manager, J. T. Morris, 310 E. 45th St., New York, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Public Works Journal Corp., S. N. Hume, J. T. Morris, Croxton Morris, W. A. Hardenbergh, S. W. Hume, A. Prescott Folwell, all of 310 E. 45th St., New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) Swetland Publishing Co., 239 W. 39th St., New York, N. Y. (Stockholders unknown).

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the months preceding the date shown above is.....(This information is required from daily publications only).

J. T. MORRIS,
(Business Manager).

Sworn to and subscribed before me this 26th day of September, 1933.
(Seal.) CROXTON MORRIS.

NOTARY PUBLIC, WESTCHESTER COUNTY, N. Y. Cert. filed in N. Y. Co. No. 321, Reg. No. 5M408. Commission expires March 30th, 1935.

Do you make regular use of the Readers' Service Dept.?—see pp. 51-54

Some Unusual Features of St. Thomas Water Purification

St. Thomas, Ontario, obtains its water supply from a catchment area of 60 sq. mi. lying entirely northeast of the city. The prevailing winds are from the southwest and carry the smoke from many railway shops to this area, where it settles. In the winter so much collects on the snow that when the spring thaw comes the water flowing to the treatment plant is almost black. The soot is easily removed by the regular treatment in a settling reservoir and filters.

Aluminum sulphate is applied in the suction pipe of the pumps, and the water passes through an aerator to conditioning tanks of the vertical spiral flow type—the first of this type to be operated in Ontario on a plant scale—where it is detained for 90 minutes. These tanks consist of 12 cells, each about 12 ft. square, with the corners filleted, built in two series of 6 each. The water passes through the partition walls alternately at top and bottom, entering each cell tangentially. The areas of the openings and difference of level between adjacent tanks are adjusted to give the entering water a velocity sufficient to keep it rotating during its stay in the cell. In addition to the rotating, the corners create eddies which entirely prevent any dead spaces except in the very bottom of the tank. As the water passes from cell to cell there is a progressive removal of turbidity and in the last cell the water between the floc particles is quite clear.

From these the water enters a settling basin with a detention period of three hours, in which from 90 to 97 per cent of the floc is removed.

Tree Planting of Gullies in Watershed Reforestation

In a paper before the Maryland-Delaware Water and Sewerage Association, State Forester F. W. Besley gives some detailed advice as to tree planting which should be very helpful to those who are reforesting watersheds.

Evergreen trees are, he says, better than deciduous except in the case of badly gullied lands. White pine requires good soil and moisture. Red pine will grow on the drier sites. Along ridges and thin soils of upper slopes, too dry for even the red pine, use Scotch pine, which is adapted to the driest and poorest sites. "Along the lower slopes, especially towards the water's edge, Norway spruce and hemlock are very desirable, particularly on north and east slopes, if not too steep. These species not only do well under these conditions but are particularly attractive in appearance.

"Special preparation is required where gullies have formed and planting operations are to be undertaken. This not only indicates the most urgent need of planting as the best permanent protection but also presents one of the most difficult problems of forest planting. It is largely an engineering problem; first, by means of terracing or ditching, the water must be led around the head of the gully and spread over the slope in such a way that new gullies will not form. Then the upper edge of the gully watts must be scraped off into the gully to reduce the angle of slope to 45 degrees or less. Brush and logs put in the bottom of the gully will also aid in holding the loose soil. Then the slopes can be planted and for this purpose the best species to use is

the native black locust, which is a rapid growing tree with a spreading root system that has a peculiar power in binding the soil. This method of procedure and the use of locust has been tried out very successfully in the Southern Appalachians in Tennessee where the erosion problem is particularly acute. An additional reason for using the locust, especially on farm lands in Tennessee, was that it produced fence post material in a shorter time than any other species and sprouted very vigorously when the trees were cut, thereby maintaining a perpetual forest cover.

"In some cases the gullies may be so deep that it may be impossible to divert the water therefrom, especially during periods of heavy precipitation. In such cases the only practical remedy seems to be to build up the bed of the gully by means of log or brush dams or stone work at short intervals. As the bed is built up by the accumulation of silt and other deposits that are washed down, the dams are progressively raised in height until the bed of the gully has reached a point where the sides can be scraped off and the planting of trees proceed as outlined above."

The Water Wheel

(Continued from page 28)

47. *t.* Coagulation with Aluminum Sulphate. By August G. Notte and Warren A. Kramer. pp. 1263-1278.
48. Laboratory Control for Water Works. By Charles P. Hoover. pp. 1279-1286.
49. Lactose Fermenting Organisms in Philadelphia's Drinking Water. By George G. Schaut. pp. 1287-1294.

The Surveyor, September 22.

50. Pontefract Corporation Waterworks. pp. 253-254.

October 6

51. Mablethorpe and Sutton Water Supply. pp. 291-292.
52. A Consideration of Water Supplies. By G. Matthew Fyfe. pp. 295-296.

October 13

53. Detection and Prevention of Waste of Water. By F. D. Ogden. p. 316.

Proceedings, Am. Soc. of Civil Engineers, October.

54. Highway Dams on Pervious Glacial Drift. Discussion by J. D. Justin and A. K. Pollock. pp. 1348-1353.
55. Actual Deflections and Temperatures in a Trial Load Arch Dam. Discussion by D. C. Henny and B. E. Torpen. pp. 1354-1357.

The American City, October.

56. The Reduction of Corrosion in Water Pipe. By Edward S. Hopkins. pp. 51-53.
57. Method of Crossing a Tidal Stream with a Water Main. By William J. Lumbert. pp. 54-55.

Water Works Engineering, September 20.

58. Water Supply of Bridgeport. By D. H. Hall. pp. 922-924.
59. Cleaning Distribution Reservoir by Siphon Drain Line. By Sidney S. Anthony. pp. 925-926.
60. Waterproofing a New Reservoir. By Edward E. Minor. pp. 927-929.
61. *c.* Laying Submerged Pipe Line. By William J. Lumbert. pp. 930-931.
62. Controlled Flushing of Mains. By Harry U. Fuller. pp. 932-966.
63. Water Hammer Tests at Croton Lake. By S. Logan Kerr. pp. 949-953.
64. Surge Control in Centrifugal Pump Discharge Lines. By Ray S. Quick. pp. 953-957.
65. Selling Water Works to the Consumer. By John P. Harris. pp. 973-974.

October 4.

66. Detecting Water Leakage and Preventing Water Waste. By Roger W. Esty. pp. 996-999.
67. Management of a Municipal Water Department. By Leland G. Carlton. pp. 1000-1003.

October 18

68. Centralized Management of a Large Group of Water Companies. By Reeves J. Newsom. pp. 1044-1046.
69. Pittsburgh's Electric Pumping Station. By S. A. Carnarius and G. H. Welch. pp. 1047-1050.

Water Works and Sewerage, September.

70. A 4,000,000 Gallon Elevated Storage Project. By Arthur H. Miller. pp. 311-316.
71. Sterilizing New Mains. By Carl Leipold. p. 321.
72. Modernization in Chlorine Handling. By Carl Leipold. p. 322.
73. Experiences in Locating Pipe Lines. By Roger W. Esty. pp. 323-326.
74. Anthracite's Superiority to Sand as a Filter Medium. By Homer G. Turner and G. S. Scott. pp. 330-331.
75. *t.* Obstacles Encountered in the Flow of Water Through Filter Beds. By John R. Baylis. pp. 332-334.
76. Cement-Lined Water Mains. Symposium. pp. 339.

Public Works, October

77. Electrically Welded Standpipe at Lake Mohawk. p. 13.
78. Simple Chlorination Equipment for Small Water Supplies. By F. E. Daniels. pp. 18 and 41.

Do you make regular use of the Readers' Service Dept.?—see pp. 51-54

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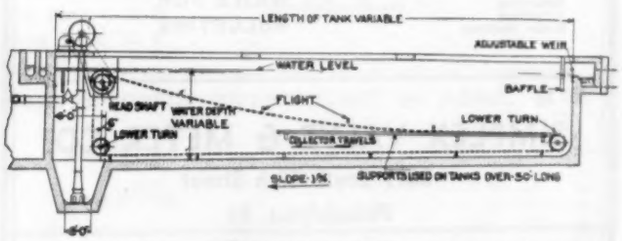

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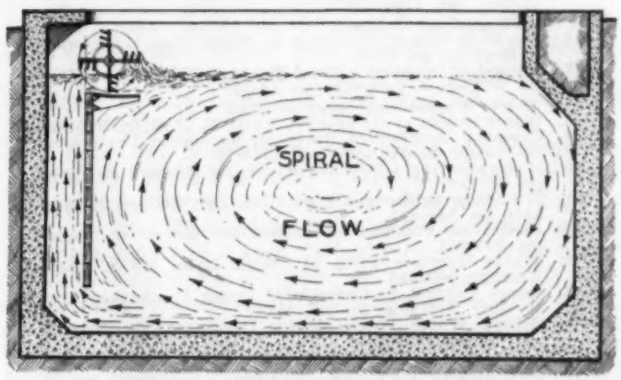
Or possibly you want to employ the activated sludge method of treatment. This cross-section suggests how readily a septic tank can be made over into an aerator tank by use of a Link-Belt STRAIGHTLINE mechanical aerator. Send for Book No. 642.



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PWA Activities in Water and Sewage Works

(Continued from page 25)

will be continued. The new FRA program approves the use of relief labor for the construction of sanitary privies by (1) permitting a person receiving direct relief to be paid for his labor in the construction of a sanitary privy at his home; (2) the construction of sanitary privies for schools and other public places; (3) the construction of a system of sanitary privies for all unsewered homes in the community when the municipality pays for the material, as in the construction of any other public utility, and retain control over the privy; and (4) the construction of sanitary privies for all unsewered houses in the community, when the property owners pay the cost of material. Such projects are to be under the direction of local or state health authorities, and all sanitary privy supervisory personnel will be appointed subject to the approval of the United States Public Health Service.

This work should be of importance in at least 18 southern and central states where a potential average of 25,000-50,000 privies should be installed per state with a good organization, and 10 per cent of this number where no organization is provided.

Stone Mountain, Georgia, installed 387 privies of the standard sanitary type by asking for bids on materials, accepting the lowest bid, and using relief labor for their installation. The total cost for labor and materials was equal to the cost of scavenger service for 1½ years—the average life of the privy in one place being 6 years—thus resulting in a considerable saving. Thomasville, Georgia, 3 cities in Florida, Orangeburg, South Carolina, and other cities in Texas and Georgia have done the same thing.

Referring to Rhode Island conditions, C. L. Poole stated that one unsewered town in that state used unemployed white collar men on unemployment relief to examine 10,000 premises with 2,600 privies, 1,300 of which were poor and 1,300 fair, but none good. Relief labor is being planned by the FRA for malaria control, drainage and rodent control.

Five Years' Operation of the Milwaukee Activated Sludge Plant

(Continued from page 11)

In connection with sedimentation, he stated: "Most notable perhaps from a comparative standpoint is the fact that the strongest sewage treated during any one of the five years in the period obtained during the year 1930, the total average daily flow treated, however, was somewhat less in quantity than that obtained during the other years. That this lesser volume of stronger sewage with its less alkaline hydrogen ion concentration was generally more resistant to treatment than the other sewages shown is rather clearly reflected in its lower effluent stability, and nitrite and nitrate content and higher nitrogen as ammonia (NH_3), although the removal percentages of suspended solids, bacteria, and B.O.D. were somewhat higher than during the other four years. To the existence of this latter condition may be ascribed the explanation that higher suspended solids removals from the effluent may reasonably be expected to be accompanied by reduced bacteria and B.O.D., the greater reduction of suspended solids in the instance of the year 1930 having been a direct reflection of the lower sewage flow and higher ash, resulting in accelerated rates of sludge settling, particularly the second or third stage light floc."

Operation and Maintenance Costs

The revenue from Milorganite has gradually decreased from $19.92 per million gallons of sewage in 1929 to $10.17 in 1932, due to unfavorable fertilizer market conditions. Comparing the revenues with the cost of Milorganite production (sludge conditioning, power, heat, supplies, labor, filter cloths, maintenance, repairs, coal, water, etc., but no capital charges), the first year showed a profit of $1.68 a ton; 1930, a loss of $2.72; 1931, a loss of $5.92; and 1932, a loss of $6.90, or a total of $198,739. (This should, of course, be compared with the cost of other methods of disposing of the sludge; also the relative inconvenience, nuisance, etc., of these should be considered.)

The average annual cost, less the Milorganite revenue, of operating and maintaining the treatment plant, intercepting sewer system, sewage pumping station, etc., but not including capital charges on the investment, was $14.78 per million gallons of sewage in 1929, $15.62 in 1930, $20.14 in 1931 and $22.93 in 1932. The cost of sewage treatment alone (exclusive of cost of waste sludge disposal) was $8.45 in 1929, $10.65 in 1930, $11.16 in 1931 and $9.39 in 1932. These costs do not include incineration of screenings and grit, but do include cost of removing them to a remote area.

A substantial part of the cost of activated sludge treatment is that of compressing air. At Milwaukee, using steam turbine driven turbo blowers, the average cost of compressing one million cu. ft. of free air to 9 lbs. per sq. in. was $3.59, with a steam cost of 32.69 cts. per 1,000 lbs. of steam. This makes the cost of air $5.40 per million gallons of sewage treated (on the basis of 1.5 cu. ft. of air per gal. of sewage); the balance—an average of $4.51—representing the cost of labor, power, light, heat, water, supplies, pumping sludge, maintenance and repairs.

Civic Committee Carries Improvement Election

The village of Bath, N. Y., on Sept. 28th voted 8 to 1 in favor of building a municipal water supply and sanitary and storm water sewer system at a cost of $370,000.

Overwhelming sentiment in favor of these improvements was created through the efficient functioning of a local civic committee which sought to explain matters thoroughly to all taxpayers.

Very frequently voters turn down proposals to construct needed sanitary improvements because they do not have full knowledge of the facts. The procedure followed at Bath should be of interest to other municipalities that are seeking taxpayers' authorization of needed improvements.

Lead Services Resist Electrolysis

Minneapolis, Minn., began in June, 1933, requiring "that lead pipe be used on all water service connections underground where there are street car tracks on the surface of any street or public thoroughfare on which such service connections shall be laid." The Engineer Dep't also required that ⅝" pipe weigh 3 lb. per foot; ¾" pipe 3 lb. 8 oz.; 1" pipe 4 lb. 12 oz.; and 1½" pipe 8 lb. It suggested that the lead pipe be wrapped with rubber and friction tape and painted with a covering of asphalt in certain places where electrolysis is known to exist.

This action was taken because the department had "found that lead will last many times longer than other metal pipes underground where electrolysis exists, especially where there are car tracks."

Engineering Meetings

NAT'L MUN. INCINERATION AMER. ROAD BUILDERS
GA. WATER WORKS AM. PUB. HEALTH N. Y. SEWAGE WORKS

National Municipal Incinerator Association:

The National Municipal Incinerator Association was formed at the Milwaukee convention of the International Association of Public Works Officials for the purpose of presenting and administering a Code of Fair Competition in the incinerator industry; also to improve the industry, foster the interests of its members, secure freedom from unlawful and unjust exactions, establish and maintain uniformity in the usage of incinerators, acquire valuable information, promote more enlarged and friendly intercourse among those engaged in the industry, and to do anything additional which may be recognized as proper and lawful purposes of trade associations.

The Association was formed with ten companies as charter members, representing more than 90 per cent of the industry, as reckoned from gross business during the past full five calender years. It is expected that at least five more members may be added quickly.

The officers elected to serve through 1934 were: President, Ralph D. Earle, Jr., Sales Manager Decarie Incinerator Corporation, New York; Vice-President, Richard M. Egan, Vice-President, Hiler Engineering & Construction Co., Pittsburgh, Pa.; Secretary-Treasurer, John E. Jackson, Manager, Incinerator Dept., Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa. All these men serve on an Executive Committee with Herbert A. Hershey, Vice-President, C. O. Bartlett Snow Co., Cleveland, and A. C. Felton, Jr., President, Nye Odorless Incinerator Co., Macon, Ga. For the present the headquarters of the association will be at the office of the President, 155 East 44th Street, New York.

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American Road Builders' Association

The official nomination for officers for 1934-1935 and directors for three years, as submitted by nominating committee elected January 20, 1933, at Detroit, Michigan, are:

For President: H. C. Whitehurst, Director of Highways, District of Columbia, Washington, D. C. For Vice-Presidents: E. L. Benedict, Vice-President, Pittsburgh Steel Co., Pittsburgh, Pa.; Chas. M. Upham, Engineer-Director, American Road Builders' Association, Washington, D. C.; Grover C. Dillman, Director of Public Service, Grand Rapids, Mich.; Stanley Abel, Supervisor, Fourth District, Kern County, Taft, Cal.

For Treasurer: James H. MacDonald, Consulting Road and Paving Expert, New Haven, Conn. For Directors, term ending 1937: Robert B. Brooks, Consulting Engineer, St. Louis, Mo.; Paul L. Griffiths, Vice-President, Koppers Products Co., Pittsburgh, Pa.; A. Lee Grover, Secretary, New Jersey State Highway Department, Trenton, N. J.; L. B. McLeod, President, L. B. McLeod Construction Company, Williston, Fla.; J. E. Pennybacker, Managing Director, The Asphalt Institute, New York, N. Y.; Geo. C. Stanley, City Engineer, Burlington, Vt.; J. Borton Weeks, President, Keystone Automobile Club, Philadelphia, Pa.

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Georgia Water Works School:

The three day short school for water works operators will be held Nov. 9, 10 and 11 at the Georgia School of Technology in Atlanta. This course will be conducted in the class rooms and laboratories of the college with the cooperation of personnel of the State Board of Health.

The purpose of this short school is to provide instruction in the practical control of water plants; also, the elements of sewage disposal will be covered. The course will include the chemical and bacteriological tests used in the control of water plants and basic tests necessary in sewage disposal plant operation. Opportunity will be given each student to perform these tests after seeing them demonstrated by an instructor.

Equipment for measuring water in the plant and the several pieces of control equipment on filters, such as venturi meters, loss-of-head gauges, rate-of-flow gauges, rate controllers, etc., will be demonstrated and explained. The care and adjustment of these devices will be covered. As far as time permits, any special problem presented by a student will be covered.

All correspondence should be addressed to W. H. Weir, Assistant Chief, Division of Sanitary Engineering, State Department of Public Health, Atlanta, Georgia.

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American Public Health Association Meeting at Indianapolis, October 9th to 12th, 1933

This meeting, including that of the Public Health Engineering Section and joint sessions with the Conference of State Sanitary Engineers and the Central States Sewage Works Association, drew a large attendance of sanitary engineers and other sanitarians, the attendance almost reaching that at the Washington meeting last year. More than half of all the state sanitary engineers were present—22 out of 42.

The high light of this, the 62nd annual meeting of the A. P. H. A., was the memorial session to Major Walter Reed and his associates on the Yellow Fever Commission, attended by several of the survivors who had participated in the investigations.

The officers elected for the next year were: For the American Public Health Ass'n—President, Dr. Haven Emerson; Vice President, Dr. William F. King; Treasurer, Dr. Louis I. Dublin; President-elect, Dr. E. L. Bishop. For the Public Health Engineering Section—Chairman, C. A. Holmquist; Vice-chairman, John R. Baylis; Secretary, Arthur P. Miller. For the Conference of State Sanitary Engineers—Chairman, A. H. Wieters; Vice-chairman, A. D. Weston; Secretary-treasurer, R. E. Tarbett.

The membership of the Public Health Engineering Section decreased during the past year. During that period two states—North Dakota and Utah—failed to replace state sanitary engineers who resigned, and three—Arizona, Indiana and Missouri—changed their sanitary engineers.

A feature of the papers and discussions was the prominence given to P. W. A. activities and other Federal aid to sanitary work. Abstracts of these discussions are given elsewhere in this issue. Abstracts of other papers also will be found in this or in coming issues of PUBLIC WORKS, among the most important of which were one by F. S. Tainter on "Abatement of Pollution of Harbor and Coastal Waters within the New York Metropolitan Area"; "Sanitary Works of Indianapolis," by C. K. Calvert; "Liquid Wastes: Their Treatment and Disposal," by Langdon Pearse; "Recent Advances in the Chemical Treatment of Sewage," by F. W. Mohlman; committee report on "Chlorination in Sewage Disposal," by Langdon Pearse; "Seeding Material for Sludge Digestion," by C. E. Keefer and Herman Kratz; "Mechanization of Sewage Treatment Works," by E. B. Besselievre; "Treatment of Trade Wastes," by L. F. Warrick; "Growth of American Cities," by H. W. Green; "Keeping Up With the Demand for Adequate Pure Water," by H. E. Jordan; and "Effect of Chemical Constituents in Water on the Human System," by J. R. Baylis.

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The date of the Fifth Annual Conference, Virginia Water and Sewage Works Assn., has been changed from Nov. 13-14 to Nov. 16-18. The conference will be held at the Hotel Warwick, Newport News, Va.

New York State Sewage Works Association

This association held its Fall meeting at the Hotel Roger Smith in White Plains, N. Y., October 27-28, 1933, President A. F. Dappert presiding. One hundred and sixty members and guests were registered.

Following registration and address of welcome by James Berg, secretary of the Westchester County Sanitary Sewer Commission, the convention opened with a brief business meeting. Four technical papers were presented Friday morning. Alexander Potter, in his paper "Joint Sewerage Works Serving Twelve Municipalities," illustrated by slides and movie films, described many unusual features of a large sewerage project. Discussion on this paper was led by W. W. Young. A paper on "Chemical Precipitation as an Adjunct to Sewage Treatment at Freeport, L. I." by Lawrence L. Luther, manager of the Department of Sanitation of Freeport, was received with much interest and discussed by Weston Gavett and Robert N. Clark. Morris Cohn presented a brief abstract of this annual report on the operation of the Schenectady sewage treatment works. W. J. Scott presented a paper "Regulations Pertaining to Qualifications of Sewage Works Operators," describing Connecticut's aims and experience, which was discussed by F. D. Stewart, principal assistant engineer, Ohio State Department of Health, and by E. B. Besselievre of the Dorr Company.

At the luncheon Herman W. Merkel, general superintendent of the Westchester County Park Commission, spoke on "Landscaping and Beautifying Sewage Treatment Works."

The afternoon was devoted to a symposium on the organization, construction and operation of the Westchester County Sanitary Sewer Commission projects, the papers presented being "Interurban Sanitation—Promotion, Legislation, Financing and Organization," by W. W. Young, Consulting Engineer of the Commission; "County Sanitary District Determination and Sewer Easement Acquisition," by F. J. Laverty, project engineer; "Trunk Sewer and Tunnel Location, Pumping Plants, Specifications and Construction," by F. C. Zeigler, project engineer; "Water Tightness in Sewers and How to Secure It," by E. C. Hallock, chief inspector; "Fine Screening, Incineration and Sterilization Plant Construction and Features," by J. W. Van-Denburg, project engineer; "Plant Operation and Effluent Disposal by Dilution," by W. R. Schreiner, bacteriologist and chemist.

In the evening I. W. Mendelsohn gave a brief talk on "Sanitation in the Far East," and a Round Table discussion was opened by W. A. Hardenbergh, W. H. Larkin, and G. A. Mowbray.

At the Round Table breakfast Saturday, Morris M. Cohn and C. C. Agar conducted the Question Box, following which an inspection trip was made in private cars to the Mamaroneck and the North Yonkers sewage treatment works and the Hutchinson pump station, all of the Westchester County Sanitary Sewer Commission. A standing committee in Research was appointed, having as its aim the stimulation and coordination of experimental and research work in sewage disposal at the various sewage treatment plants and universities in this state.

The next meeting of the association which will be the Sixth Annual Meeting, will be held in New York City January 16, 1934.

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The North Carolina Sewage Works Association has changed the date of its meeting to Nov. 13-15, at the Vance Hotel, Statesville, N. C.

Personal Notes

Malcolm Pirnie, consulting engineer of New York, has been appointed a Deputy Administrator of the National Recovery Administration.

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William Wright has been appointed manager of the New York office, 1451 Broadway, of D. H. Haering Co., Inc., Chicago, water consultants.

Letters to the Editor

Lake Mohawk

Oct. 24, 1933.

Read the article in "Public Works" in regards to the electrically welded standpipe at Lake Mohawk which indeed was very good and wish to thank you for same.

We have done considerable developing since your last visit and many things, interesting to you, have happened. For instance, we were only troubled with weeds in the lake for one year. For the past two years our weeding machine has not done any work at all outside of towing the pile driver and moving equipment across the lake, which I am very thankful for. I might say that I have received requests for information from Water Departments all over the country, even up to this year, although your article appeared a couple of years ago. . . .

I certainly would be glad to have you drop in sometime as it would be a real pleasure to show you around.

Very truly yours,

HARRY C. CALLAHAN,
Construction Engineer.

The Arthur D. Crane Co.,
Sparta, N. J.

P W A Wage Scale

October 19, 1933.

I want to compliment you for the article you prepared under "The Public Works Wage Scale Muddle." This article as far as my experience indicates hits the nail on the head and is one of the big stumbling blocks to the furtherance of the Public Works Act. I was wondering if you could follow this up with a plea to the Federal Government to delegate more power to the Advisory Boards and the Engineers in the various states to establish wage levels that are appreciably above those existing heretofore but which are not so incongruous as some of those that you have listed in your table on page 31. I have so written to Secretary Ickes myself simply because I could not contain myself further. There is certainly a difference in the cost of living in rural sections as contrasted with urban centers and certainly the Federal authorities ought to recognize this even though it means a change of front on their part.

Our State Legislature is now in session, having convened yesterday and presumably the session will be taken up mostly by the two groups, one interested in using State money alone and the other interested in using Federal funds. A change in the wage schedules would to my mind, as suggested above, clear the skies immediately.

Yours very truly,

R. C. BECKETT,
State Sanitary Engineer.

State Board of Health,
Dover, Del.

Grants Without Loans

October 26, 1933.

We are very much interested in the first article in your recent magazine entitled, "How to Get Federal Funds for Municipal, County and Other Work."

We were not aware of the fact that it is possible to receive a direct grant without also making a loan of the other 70% of the cost of the project. We have some projects here in the city calling for sanitary sewer construction and laying of water mains, that we might be in position to finance from local funds providing we could receive the 30% grant.

Can you tell us just how we must proceed in making our application for a Direct Grant of funds without also making a loan of the other 70%?

Whatever information you can furnish us will be greatly appreciated.

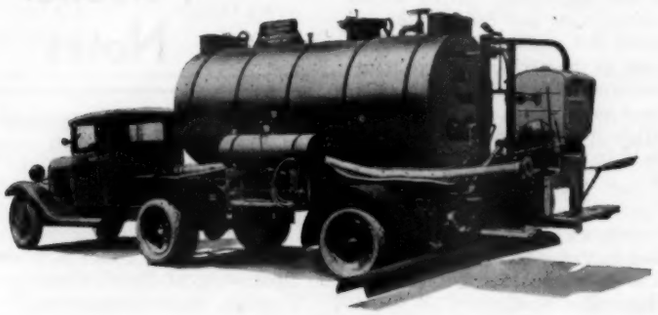
Yours very truly,

OSCAR PETERSON,
City Clerk.

Holland, Mich.

Editor's Note: Nearly half of the allotments made from the PWA fund for non-federal projects have been for grants only. The application for grants only are made to the same offices and in the same way as for grant and loan. If no loan is desired, it will not, we are informed, be necessary to answer all the questions required for both grant and loan, since the ability of the city to repay a loan is not in question. Ask your PWA State engineer (Mortimer E. Cooley, 10 Fisher Bldg., Detroit) to advise you on this point. In the past, applications for grant only have gone through more quickly than for both grant and loan.

New Equipment in Pictures



Badger Oil Distributor

The Badger Oil Distributor

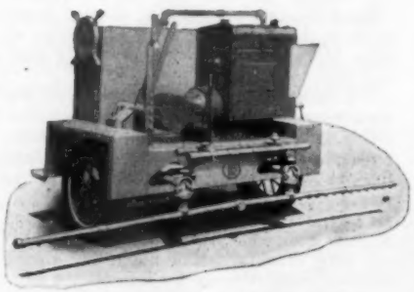
Its manufacturers report the Badger is a complete assembly mounted on an electrically welded steel frame and can be mounted on any standard make truck chassis of proper length, or preferably on a semi-trailer.

A pressure pump insures the most effective distribution of the surfacing material. The pump is independently driven by a four cylinder 20 horse power gas engine, saving the power of the truck's motor for the transportation of its load.

The surfacing material is heated by two large kerosene burners of the generating type. They are mounted at the rear of the tank and shoot hot gases through two 7 inch flues into a large combustion chamber. The fuel for the burner is supplied from a tank at from 50 to 80 lbs. pressure.

The detachable spray bars may be furnished in lengths to take care of spreads of from 9 to 20 feet, so that at least half of a wide road and the entire width of a road up to 20 feet can be surfaced in one operation. The distribution of the material is controlled by the operator on a platform at the rear of the tank. Quick-opening valves are within easy reach of the operator.

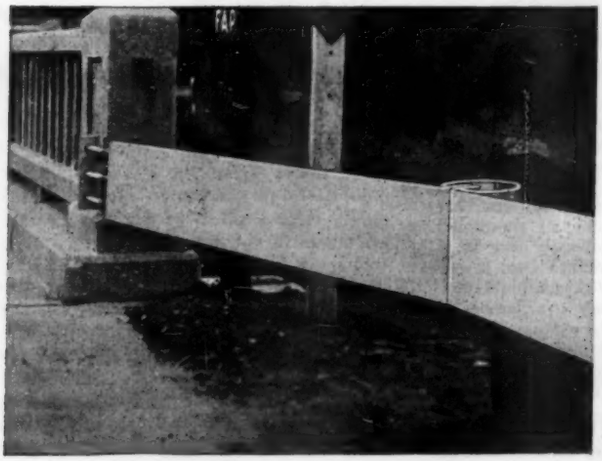
The Wisconsin Foundry & Machine Co., Madison, Wis., the manufacturers, say that the Badger Distributor will distribute all grades of oil, tar and asphalt used in the construction and maintenance of bituminous roads. An 8-page folder giving every detail in connection with the distributor is available. If you are interested in oil distributors write for that folder.



The Littleford Trail-O-Distributor

Duraguard—A Highway Guard:

The Truscon Duraguard, a recent development of the Truscon Steel Co., Youngstown, Ohio, meets the requirements for a guard rail for highways insofar as safety, visibility, low cost, economy and appearance is concerned. The illustration herewith shows the general appearance of Duraguard and its resilient type of construction.



The Duraguard Highway Guard

Littleford Trail-O-Distributor:

The Trail-O-Distributor when used in conjunction with a number of truck mounted tanks, eliminates the hauling back and forth of a complete pressure distributor. It remains on the job and, as one tank is emptied, and another comes up to take its place, the distributor is kept in constant operation.

This outfit greatly reduces the usual necessary heavy capital investment as it eliminates a number of pressure distributors and is in itself a low priced unit.

Because of its light weight it can be used in states where road load restrictions are severe.

The Trail-O-Distributor is the working end of a Littleford Pressure Distributor mounted complete on a separate trailer unit. The high speed trailer is equipped with pneumatic tires, Timken roller bearings, semi-elliptical springs and an adjustable tongue which can be made to fit trucks of any height or make.

After the spray bar on the Trail-O-Distributor is adjusted to the desired position, it is unnecessary to make further adjustment when supply tanks are changed — the adjustable tongue takes care of differences in truck heights and the spray bar remains in the correct position.

The Trail-O-Distributor can be provided with either a 200 or 300 gallon pump. It has the Littleford Single Valve Control whereby it is possible to suck material from spray bar back to tank, thereby entirely eliminating dripping after spraying is cut.

Another important feature is that all pipe fittings, pump, and valve mechanism are enclosed in a chamber enabling the operator to warm these parts when operating in cool weather. It is also arranged so that a burner can be placed in this hood.

Gardner-Denver Wagon Drill

Wagon Drills:

Wagon drills allow the advantages, on relatively small jobs, of large drills and rapid work. Their use is feasible and economical on most highway and railroad work and in quarries wherever down holes 20 to 35 feet in depth are to be drilled. The new equipment has been brought out by the Gardner-Denver Co., Quincy, Ill.

Readers' Service Department

To help you in your work, any of this **INDUSTRIAL LITERATURE** will be sent **FREE** upon request.

IT is a good practice to check this list regularly because descriptions of new bulletins are always being added.

Construction Materials and Equipment

Asphalt Heaters

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

9. Illustrated manual No. 11 describes "Hotstuf," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Asphalt Mixing Plants

10. Precise engineering control of bituminous pavement construction is provided at low initial cost by the new Blaw-Knox (Madsen) portable asphalt mixing plant which is described and illustrated in a new catalog just issued by Blaw-Knox Company, 2019 Farmers Bank Building, Pittsburgh, Pa.

Asphalt Plants

11. A very complete 24 page booklet covering all five sizes and types of Iroquois Asphalt Mixing Plants which are particularly adapted to meet the needs of municipalities and contractors, providing maximum output at minimum cost. Barber Asphalt Co., 1600 Arch St., Philadelphia, Pa.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subjects suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Solvay Sales Corp., 61 Broadway, N. Y. C.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Bridges, Culverts and Concrete Products." It includes reports from the Highway Research Board, the Bureau of Public Roads and State Highway Departments. Columbia Products Co., Barberton, Ohio.

Concrete Mixer

44. Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size, The Jaeger Machine Company, Columbus, Ohio.

Crushers

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Gallion Iron Works & Mfg. Co., E. Jeffry Mfg. Co., Columbus, Ohio.

Culverts

60. "In diameters up to 10 feet and larger . . ." just issued by the Armco Culvert Mfrs. Assn., tells a good deal about drainage problems and their solution. 32 pages about drainage and multi-plate culverts.

Explosives

74. "Use of Explosives for Settling Highway Fills. A new booklet which fully explains by diagrams and charts the three methods developed after many tests by the Du Pont engineers, which singly or in combination will quickly and efficiently do your job. Just issued by E. I. Du Pont de Nemours & Co., Inc., Explosives Dept., Wilmington, Del.

Graders

76. Latest information about Gallion Motor Patrol Graders, Road Maintainers and Leaning Wheel Graders with hydraulic control is contained in a new series of illustrated catalogs, Nos. 125, 130, 135 just issued by the Gallion Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio.

78. The No. 101 Austin Leaning Wheel Grader is completely described and illustrated in Bulletin No. 1238 which shows operation of Z-Bar, back sloper, bank cutter, etc. Published by The Austin-Western Road Machinery Co., 400 North Michigan Ave., No. A5, Chicago.

79. Four new bulletins have just been issued describing and illustrating the Austin No. 77 Motor Grader. Contain construction details, specifications and weights. The Austin-Western Road Mach. Co., 400 N. Michigan Ave., No. A5, Chicago, Ill.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Joint Filler and Line Marker

88. Bulletin No. G-9 issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their new No. 91 Joint Filler which is used to fill horizontal and center joints with hot asphalt. It can be equipped to apply an asphaltic center line as it fills the center joint. This bulletin also describes the Littleford Traffic Line Marker.

Joint Filling Pot

89. A supplement to Bulletin No. E-5 has been issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describing their cone-shaped crack filling pot No. 86-B. The chief feature of this pot is that it is springless—there is no mechanism to get out of order. It is used to fill cracks and joints in concrete pavements and interstices in brick or granite block pavements.

Loaders and Unloaders

97. Portable Loaders and Unloaders. Folders: Nos. 1248, 1298 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket elevators for different classes of work; and No. 1256, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, Philadelphia.

100. Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery. Link-Belt Co., Chicago, Ill. General Catalog No. 500.

Motor Trucks

105. Full information about their complete line of motor trucks, all powered by six-cylinder "truck-built" engines of uniform valve-in-head design, will be sent promptly. General Motors Truck Co., Pontiac, Mich.

Paving Materials

109. A 36-page booklet with 66 illustrations has just been issued by the Barrett Co., giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. 24 pages. The Barrett Company, 40 Rector Street, New York.

112. Complete directions for surface Cut Back Asphalt are contained in a 36 treatment and bituminous surfacing with page data book. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Road Machinery

126. A new picture book of the Austin-Western Line of road machinery showing the application of road graders, road rollers, elevating graders, crawler and wheeled wagons, crushing and screening plants, shovels, cranes and excavators, scarifiers and many small tools, is contained in Catalog No. 1247. Copies available on request at The Austin-Western Road Machinery Co., 400 North Michigan Ave., No. A5, Chicago.

127. "Road Machinery Illustrated." New illustrated bulletins on the motor rollers, three-wheel and tandem rollers, motor graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Ford-

★Paste on post card and mail. 11-33

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son tractors, and straight and leaning wheel graders. Galion Iron Works & Mfg. Co., Galion, O.

Rollers

132. A 32-page book in four colors featuring a complete line of road rollers. 8¾ x 11, leatherette cover, numerous action pictures. Buffalo-Springfield Roller Co. of Springfield, Ohio.

133. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers and their uses.

134. "The Chief," a six cylinder roller of advanced design and construction is fully described in an illustrated catalog just issued by the Galion Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio. Gives complete details of the very latest development by this company.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., Chicago, Ill.

Shovels, Cranes and Excavators

145. The Austin Badger, a new, fully convertible ¾ yard crawler shovel, made by The Austin-Western Road Machinery Co., 400 North Michigan Ave., No. A5, Chicago, is fully described and illustrated in their Bulletin No. 1236.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines. 910 S. Mich. Ave.

Steel Posts

160. Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport, Pa.

Tires, Truck and Tractor

165. Speed and economy in use of solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Tool Boxes

167. Bulletin No. G-6 issued by Littleford Bros. 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates the Han-DeeBox, a portable tool box of all steel construction. This tool box is equipped with a special locking device that locks both covers at the same time. No padlocks are used. Littleford trailers, lead melting furnaces, and "Hot Dope" Kettles for pipe coating are also described in this bulletin.

Sanitary Engineering

Activated Carbon, Aqua NUCHAR

380. For low cost removal of tastes and odors from potable waters. Used by more than 400 municipalities. For literature address Industrial Chemical Sales Company, Inc., 230 Park Avenue, New York.

381. Proportioneer's Inc., 737 N. Michigan Ave., Chicago, describe in an 8 page folder their mechanical devices for controlling accurately and automatically the flow of fluids used for treatment of water supply and sewage. Ferr-O-Feeder —diaphragm pump for Ferric-Chloride or other corrosive fluids; Chlor-O-Feeder for Hypochlorate solutions. Write for a free copy.

Ferric Chloride

382. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

383. Loughlin Clarifying Tanks for the more complete removal of suspended solids from sewage and industrial wastes at lower cost are described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

Sludge Drying

385. Relatively dry cake sludge in demand for fertilizer is produced by automatic continuous vacuum filters like those used in Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C. Write for literature. Oliver United Filters Inc., 33 West 42nd St., New York, N. Y.

Activation and Aeration

390. A booklet of value to sanitary and chemical engineers describes Norton Porous Mediums of bonded fused alumina (strong chemically stable, uniformly permeable) and their use in aeration of water and sewage. Norton Co., Worcester, Mass.

Glass Covers

393. Full details regarding the use of Lord & Burnham Glass-Covers at Dayton, Ohio; Highland Park, Ill.; Fostoria, Ohio; and Bloomington, Ill., are given in bulletins Nos. 10, 11, 14, 15. Issued by Lord & Burnham, Irvington, N. Y.

Jointing Materials

401. G-K Compound for vitrified clay sewers, MINERALEAD for bell and spigot water mains, also M-D Cut-Ins for making house connections. Atlas Mineral Products Company, Mertztown, Pennsylvania.

402. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Meters, Sewage and Water

405. Just issued. Every sanitary engineer should have a copy of this new 32 page booklet describing the applications, types and distinctive features of the new Bailey meters for sewage treatment and water supply. Sent promptly. Bailey Meter Co., 1027 Ivanhoe Road, Cleveland, Ohio.

Pipe Forms

407. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Screens, Sewage

417. The simple, automatic, Loughlin self-cleaning traveling screen is fully described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link-Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

419. An illustrated booklet showing installations, and complete details regarding the 19 exclusive improvements which are featured in Shevlin Fine Disc Screens will be sent promptly by the Shevlin Engineering Co., Inc., 227 Fulton St., New York, N. Y.

420. A useful new bulletin for all those interested in sewage disposal, describing some of their proven equipment such as self-cleaning bar screens, grit conveyors, sludge collectors and shredders, has just been issued by the Jeffrey Mfg. Co., Columbus, Ohio. Includes diagrams and many illustrations.

Screens

424. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

426. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Conditioning

382. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

Treatment

429. A new series of bulletins describing their full line of sewage treatment equipment—Fine Screens, Schofield Bar Screens, Vacuum Filters for Sewage Sludge, Decarie Screenings Incinerators, Schofield Bar and Fine Screens, Vacuum Filters for Sewage Filtration and Pneumatic Ejectors for Sewage Screenings—are ready for distribution on request to Municipal Sanitary Service Corp., Room 2703, 155 East 44th St., New York, N. Y.

430. Separate bulletins showing their many lines of sewage treatment equipment will be sent promptly by The Pacific Flush Tank Co., Chicago and New York. The latest is No. 110 describing tray clarifiers.

431. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters Inc., 33 West 42nd St., New York, N. Y.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., and Philadelphia.

Snow Removal

344. "Control Winter Drifts"—A new folder giving full details regarding use and construction of the Mattson snow fence has just been issued by the Mattson Wire & Mfg. Co., Peoria, Ill. Illustrated in two colors.

345. "Standard and Heavy Duty Reversible Blade Snow Plows for Motor Trucks," a new bulletin just published by the Monarch Mfg. Co., East Front St., Wilmington, Del. Illustrated. Contains complete descriptions and specifications.

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

New Equipment in Pictures

A New Self-Priming Centrifugal Pump

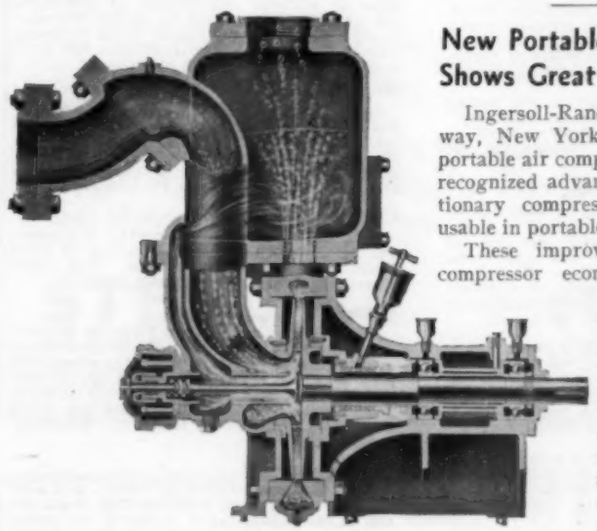
Ames Pump Co., 30 Church St., New York, N. Y. (a subsidiary of The American Locomotive Co.) is making a self-priming centrifugal pump. The self-priming is accomplished by using the wet vacuum principle with an effective controlling device.

A small quantity of liquid is pumped to the entrance of the impeller to establish a seal. Pumping the liquid at the suction inlet entrains air from the suction line, which air is then discharged with the liquid into an air separator, where air rises to the top of the separator while the liquid, free from air, returns to the suction entrance to repeat the cycle and entrain additional air. This process continues until sufficient air has been removed from the suction pipe to fully prime the pump. After priming, the main pump begins its operation, the expansion tank serving as an enlarged section of the discharge line. When not needed, the regulator closes off the priming action entirely.

The sectional view indicates the hydraulic passages necessary for the priming process which have been developed to reduce to a minimum the power required for priming.

The firm also makes an automatic-priming sewage pump, trash handling type, in which a dry vacuum pump and the centrifugal pump operate simultaneously during the priming period. The complete unit is placed above the source of supply; no working parts are submerged, thus affording quick and easy access to the interior of the pump. With this type of prime, suction lifts of 27 ft. at sea level are possible.

An 8-page folder issued by the manufacturers gives complete information in detail. Write for a copy if you are interested in centrifugal pumps.

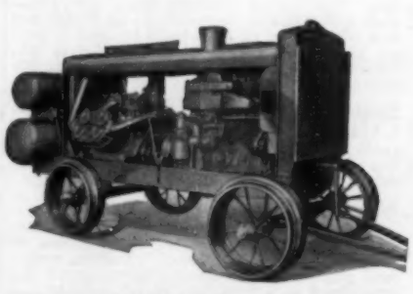


Ames self-priming centrifugal pump

New Portable Compressor Shows Great Economies

Ingersoll-Rand Company, 11 Broadway, New York, has developed a new portable air compressor which adapts the recognized advantages of two-stage stationary compressors and makes them usable in portable units for the first time.

These improvements give the new compressor economies and efficiencies never before attained in portable machines. Tests show that, size for size, the new compressor will deliver 23 per cent more compressed air than previous models. Expressed in another way, it will produce an equal volume of air with 25 per cent less fuel.



Ingersoll-Rand Portable Air Compressor

Emco sewer gas meter

Sewage Gas Meters Give Accurate Record at Disposal Plants:

Many municipalities are using gas from digesters of sewage treatment plants as a source of heat or power. So that accurate records as to savings effected may be kept, it is necessary to measure the gas.

The Pittsburgh Equitable Meter Company, Pittsburgh, Penna., after a careful study of various conditions and thorough laboratory and field tests, has announced the Emco Sewer Gas Meter. This meter is built in several sizes to take care of any volume requirements. All of the features embodied in Standard Emco meters are included plus additional constituents required for this particular service. Further information will be furnished by the company to those desiring it.

Books and Booklets

Therometers and Pressure Gauges:

Brown Instrument Co., Philadelphia, Pa., has just published Catalog No. 6702, 80 pages, which gives full information on the new Brown indicating, recording and controlling thermometers and pressure gauges.

Oil Burner Units:

Littleford Bros., Cincinnati, Ohio, have issued Bulletin I-10, covering oil-burner units of especial value in connection with cold weather work.

Road Tar Consistency Relationship Chart:

A chart to facilitate conversions of consistency of coal tar road materials has been prepared by Koppers Products Co., Pittsburgh, Pa. It allows ready interpretation of the consistency by one method of test in terms of a different method, or in terms of the same method but at a different temperature.

Highway Guards:

A new booklet covering Tuthill Highway Guards and giving results of tests by various states of guard rails. Tuthill Spring Co., 760 Polk St., Chicago, Ill.

If Your Car Had Wings:

This booklet contains a simple and clear discussion of highway economics, in non-technical language. It is issued by the Portland Cement Association, 33 West Grand Ave., Chicago, Ill.

Steel Sheet Piling:

The Inland Steel Company, Chicago, has just published a new catalog on Inland Steel Sheet Piling. It gives engineering information on the complete line of Inland Sections—three of them new—together with essential data for construction work, all in convenient form for use in office, in drafting room, and in the field.

Index to Advertisements

359. Gallion Iron Works and Mfg. Co., Gallion, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

Road and Street Maintenance

Asphalt Heaters

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

Asphalt Mixing Plants

10. Precise engineering control of bituminous pavement construction is provided at low initial cost by the new Blaw-Knox (Madsen) portable asphalt mixing plant which is described and illustrated in a new catalog just issued by Blaw-Knox Company, 2019 Farmers Bank Building, Pittsburgh, Pa.

200. For general construction and maintenance, the Original Improved "Hotstuf" Asphalt Heater, an economical oil burning heater. Mohawk Asphalt Heater Co., 56 Weaver St., Frankfort, N. Y.

Bituminous Material Handling

201. "Handling Bituminous Road Materials." This is a new and valuable booklet covering handling and heating of bituminous materials for low cost road construction and maintenance. Full data regarding Cleaver-Brooks equipment. Cleaver-Brooks Co., 740 North Plankinton Ave., Milwaukee, Wis.

Dust Control

209. "3000 men put back to work in a single county." A new folder just issued by the Solvay Sales Corp., 61 Broadway, New York City, outlining a road program which is a relief program. Sent promptly on request.

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance.

211. "Dust Control," a concise, handy pocket reference on control of dust by use of 3C Calcium Chloride. Illustrated. Issued by the Columbia Products Company, Barberton, Ohio.

212. "Wyandotte Calcium Chloride Prevents Dust the Natural Way,"—a publication, fully illustrated, treating on Dust Control, economical road maintenance and methods of application, issued by the Michigan Alkali Company, 10 E. 40th St., New York City.

Dust Laying

213. Full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost. Solvay Sales Corporation, New York.

Emulsion Sprayers

214. A complete line of emulsion sprayers is described in Bulletin No. G-5 recently issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio. Littleford Emulsion Sprayers will spray any type of asphalt emulsion used for penetration patch work or curing concrete. They are also used to spray silicate of soda and weed exterminators.

Surface Heaters

220. The "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is described and its use illustrated in Bulletin 16. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Road and Paving Materials

Bituminous Materials

226. Full details concerning the uses and advantages of Lincolnite Pulverized Petroleum Asphalt, Linco Road Oils, Cutback Asphalt Cement and Penetration Asphalt Cements will be sent free on request by Lincoln Oil Refining Co., Box 251, Robinson, Ill.

227. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

228. A new booklet has just been issued by The Barrett Co., 40 Rector St., New York, describing and illustrating the uses of each grade of Tarvia and Tarvialithic. 32 excellent illustrations.

229. A new series of concise and authoritative manuals of construction covering the latest developments in road-mix and surface treatment types as well as the standard asphalt pavements. These contain the best that has been developed by study, research and practical application in all types. Manual 1—Road-Mix Types is now ready for distribution. The Asphalt Institute, 801 Second Ave., New York, N. Y.

229A. Surface Treatment Types, Asphalt Road Construction Manual No. 2. Full details on surface treatments. 14 chapters, 128 pages. The second of those tremendously valuable and handy little manuals put out by the Asphalt Institute, 801 Second Avenue, N. Y. Sent on request.

Brick, Paving

230. Full information and data regarding the use of vitrified brick as a paving material, cost, method of laying, life, etc. National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. 47 pages. The Dow Chemical Company, Midland, Mich.

Gutters

240. "Brick Gutters and Parking Strips." A study dealing with the problems faced in the proper construction of gutters and how they can be overcome. Covers design, construction and results. Well illustrated. Just issued by the National Paving Brick Ass'n, National Press Building, Washington, D. C.

Jacking Culverts

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passageways under streets, highways and railroads. "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

Maintenance Materials and Methods

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with "Tarvia-K.P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

Miscellaneous

Oil Burner Units

500. Torch-type circular-type, low pressure and Venturi burners are all described and illustrated in bulletin I-10, just issued by Littleford Bros., 452 East Pearl St., Cincinnati, Ohio. Explains uses, how to operate, etc.

Steel Posts

160. Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport, Pa.

Noiseless Manhole Covers

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

Barrett Tarvia

GOOD ROADS at LOW COST

The completed road—easy-riding, skid-safe, all-weather.

Both photographs were taken in December, 1932.

Constructing Glenside Avenue, Watchung Reservation, near Summit, New Jersey. Tarvia-lithic.

GLENSIDE AVENUE, near Summit, New Jersey, is typical of what can be done with Tarvia or Tarvia-lithic and Barrett service—even under adverse conditions.

Tarvia-lithic construction was begun in December, 1932, and carried on through the winter. Inexperienced labor was used, drawn from the ranks of the unemployed, and the result was a completely satisfactory, easy-riding, skid-safe, all-weather pavement.

If you have urgent construction, maintenance or repair work to do, it may not be necessary to wait until spring, even though the road season is "officially closed." Tarvia and Tarvia-lithic can be successfully applied in almost any weather except actual snow or rain.

Talk it over with the Tarvia field man. He will tell you how Barrett's speedy and dependable service can help you. 'Phone, wire or write our nearest office.

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